With the

Badische Anilin- & Soda-Fabrik's

compliments

for own use only.

The Alizarine Colours

of the

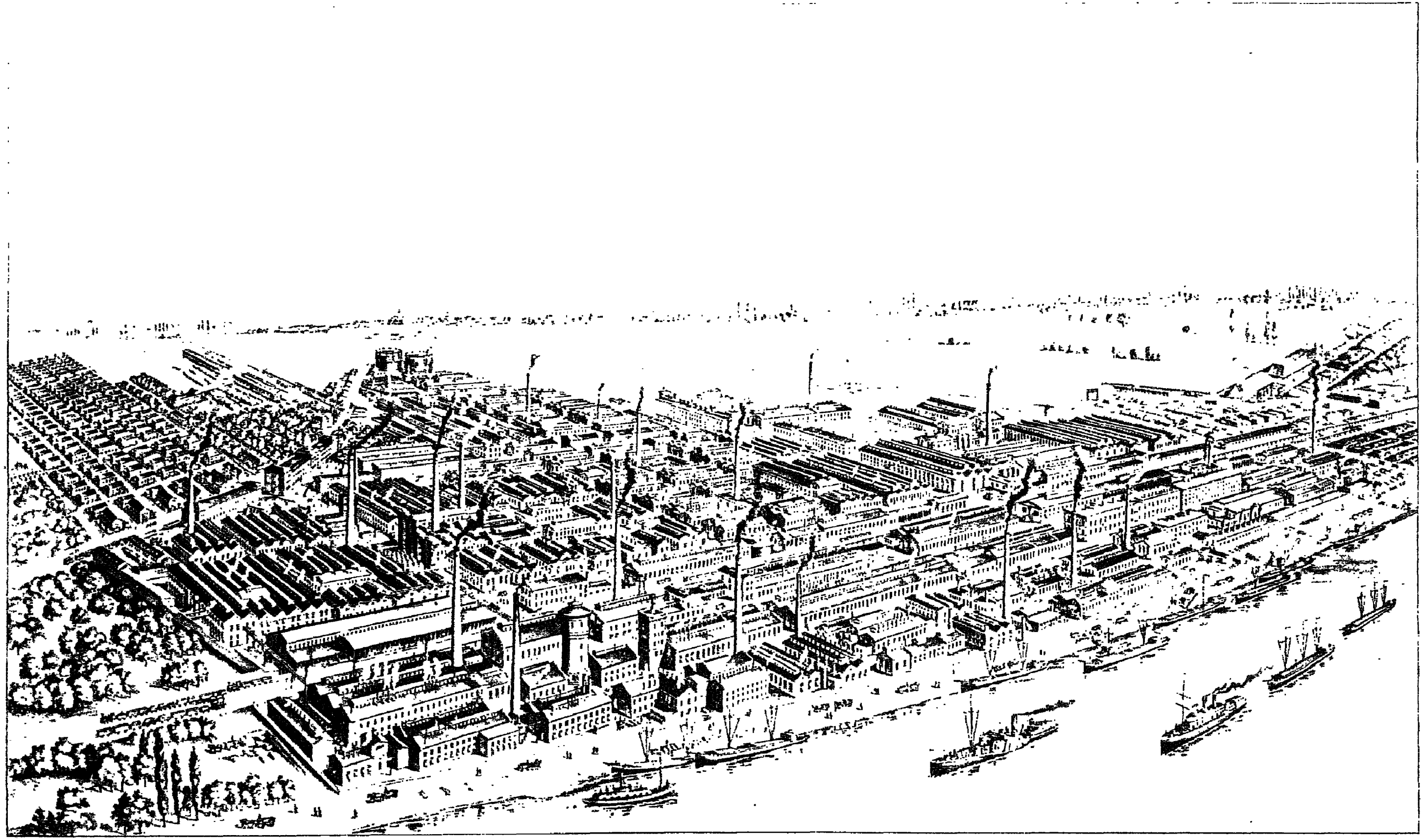
Badische Anilin & Soda-Fabrik

Ludwigshafen o/Rhine

and

their Application on Cotton, Wool, Silk etc

I.



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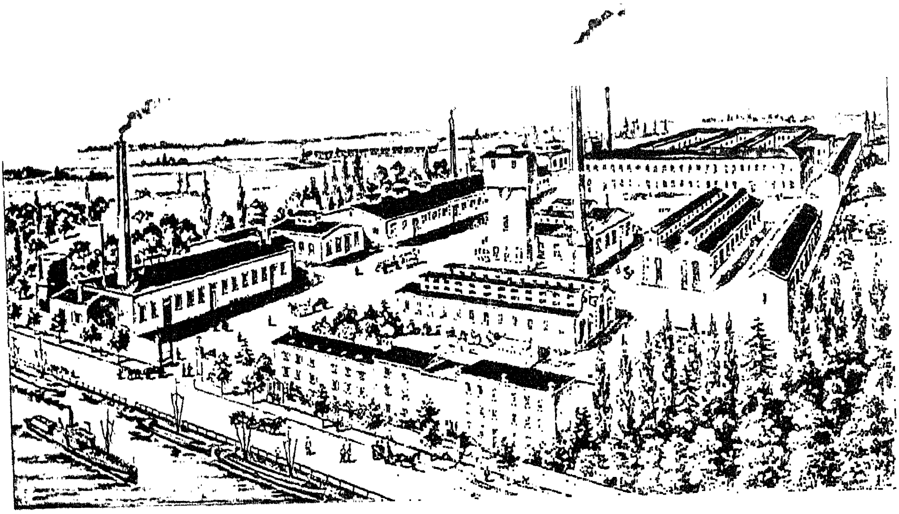

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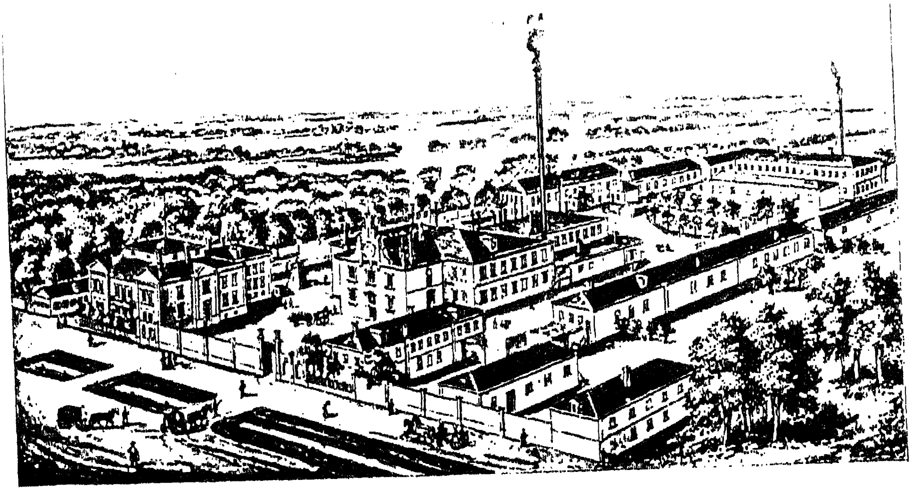

MOSCOW WORKS.

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General Part.

Introduction.

THE INDUSTRY of the Artificial or Coal Tar Colours has in the comparatively short time of its existence largely participated in the enormous development of the chemical industry during the present century of discoveries and inventions. Scientific researches combined with practical work have led to the discovery of many beautiful, brilliant and very valuable dyestuffs. These are prepared from coal tar which was formerly considered to be a troublesome and useless bye-product.

A thorough knowledge of their constitution and properties, and the action of the various mordants and other auxiliary products, is necessary for their rational application.

By means of chemical researches, theoretical explanations and practical proofs have been found for all details of the formerly empirical dyeing process, and thus the ancient art of dyeing has now been raised to a science.

One group among the multitude of coal tar colours is very conspicuous owing to its members being exceptionally fast to light, air, alkalies (milling and washing), acids (carbonisation), chloring, and stoving, viz: –

The Alizarine Colours

which on this account have secured for themselves a permanent position in the dyeing industry and at the present time are quite indispensable to the dyer.

Alizarine Red,

the oldest representative of this series is found — together with Purpurine — in Madder, which colouring matter has been long known and appreciated on account of the excellent qualities it possesses for dyeing all kinds of textile fabrics.

Scientific researches and experiments with Madder led to the artificial production of Alizarine on a manufacturing scale, and it became the rival of Madder and soon replaced it.

The Badische Anilin- & Soda-Fabrik commenced the manufacture of Artificial Alizarine in 1869, and since then have discovered and manufactured on a large scale a great number of Alizarine dyes which are continually gaining ground in Cotton, Wool, and Silk-dyeing.

Theory of the Dyeing Process.

As already indicated, Dyeing has in the course of this century been raised from the position of an Art to that of a Science.

A science, however, must have hypotheses and theories, and the science of dyeing is not without them. The oldest hypothesis is

The Mechanical or Physical Theory,

according to which the colouring matters are mechanically precipitated in the material being dyed and held there by physical causes such as adhesion, etc. For instance the dyeing of cotton with Congo Red would be explained in this manner, that infinitely small particles of the dye, its molecules, fix themselves in and upon the cotton fibre, and are held there in a mechanical way. However, this hypothesis does not explain a good many dyeing operations.

For example, it does not explain the fact that some dyestuffs give fast colours whereas others give colours of very inferior fastness. Moreover it gives no reason why some dyestuffs are especially suited for wool and others for cotton. Short-comings of such a nature made it necessary to adopt

The Chemical Theory of Dyeing.

According to this hypothesis dyeing is due to a chemical combination of dyestuff and fibre. Thus, a skein of cotton dyed with Magenta represents a chemical combination of Magenta with the cellulose of the cotton; a Scarlet dyeing being a compound of scarlet molecules and the constituents of the wool fibre.

The question, which of the two hypotheses briefly stated above deserves greater credit is still undecided and remains an object for further study.

From a practical point of view artificial dyestuffs can be divided into two classes: —

1) **Substantive Dyes,** i. e. those which possess properties enabling them to dye the textile fibre without the aid of mordants. This group contains Magenta, Congo Red, Scarlets, etc.

2) **Adjective Dyes,** i. e. such as alone possess no tinctorial properties and can only dye the fibre with the help of mordants, metallic salts, etc.

To this group belong the **Alizarine Colours.**

One can, however, draw no sharp line between the two groups as some dyes belong as much to one group as to another, but the above classification is sufficient for characterizing the Alizarine Colours.

In a chemical sense the Alizarine Colours are weak acids which combine with the various metallic oxides, forming salts of characteristic colours, the so-called

Colour Lakes.

These lakes represent the colours with all their good properties, but ready made they have no affinity for the cotton or wool fibres, and therefore the work of the dyer is to produce them on the fibre.

The Alizarine Colours produce coloured compounds with all metallic oxides under suitable conditions. For instance, Alizarine Red dissolves in soda-lye forming a violet sodium salt, and lime, alumina, chrome, or iron salts, added to this solution give rise to coloured, insoluble precipitates of the respective salts. It is these metallic salts that the dyer calls

Mordants.

However, among the great number of Alizarine Colour Lakes only a few possess properties which render them fit for dyeing purposes.

The following metallic oxides yield beautiful and fast colour lakes with the various Alizarine Colours: --

Alumina
Lime (only in conjunction with alumina)
Iron oxide
Chrome oxide
Zinc oxide
Nickel oxide
Tin oxide.

On account of the difference in nature of the Alizarine Colours many do not give good results with all the above mentioned oxides as mordants.

The nature of the material to be dyed must also be considered in choosing the mordants, but more definite information as to the available mordants will be found in the description of the dyes.

The combination of dyestuff and mordant, i. e. the actual dyeing operation, may be brought about in the following three ways: —

1. Dyeing on Mordanted Material.

The material is first treated under suitable conditions with the mordants and in this manner impregnated with metallic oxides. In a second and separate operation, i. e. dyeing, the combination of mordant and dyestuff is attained.

2. Dyeing under subsequent treatment with the mordant.

The unmordanted material is first impregnated with the dyestuff, which is then converted into a colour lake by subsequent treatment with the mordants.

3. Dyeing under simultaneous application of mordants and dyestuffs.

The material is subjected to the simultaneous action of mordants and dyestuffs, the colour lake being fixed as it forms on the fibre, a process extensively used in calico-printing.

Which of these three methods can be applied depends on the nature of the dyestuffs and mordants, also upon the material to be dyed.

Description of the Alizarine Colours.

Alizarine Red.

As already stated Alizarine Red is the oldest Alizarine dyestuff, and together with Purpurine constitutes the colouring matter of Madder and its derivatives (Garancine, etc.).

Madder has been known for many centuries and was used for dyeing **cotton** (Turkey-red) and **wool** (Madder red). The preparations from Madder were principally used in **calico-printing** to produce fast red, violet and black colours. The introduction of artificial Alizarine produced a great revolution in Turkey-red dyeing and calico-printing; the tedious operations being much simplified owing to the much greater purity of the artificial Alizarine. On account of this purity and the beauty of the colour produced, entirely new effects were produced in calico-printing which were altogether unknown when working with Madder.

The application of Alizarine is also much easier and more reliable than that of Madder, as Madder varies according to its origin, whereas Alizarine has always the same degree of purity. Under such circumstances Madder could not compete with Alizarine and was finally completely replaced by it.

Madder had been the object of numerous researches by various scientists at quite an early date which resulted in identifying the chemical nature of the dyestuff during the decade 1860 to 1870.

In 1868 two German chemists *Graebe* and *Liebermann* succeeded in producing one of the constituents of the colouring matter of the Madder root, i. e. Alizarine.

Further scientific investigation in conjunction with *Caro,* supported by experiments in large chemical works, led in 1869 to the manufacture of artificial Alizarine, which is carried out as follows.

Anthracene, a hydrocarbon of the high boiling constituents of coal tar is oxidized and *Anthraquinone* obtained. This is treated with fuming sulphuric acid, and then converted into Alizarine by heating with caustic soda in closed vessels. According to the method of working three chemically different dyestuffs are obtained.

Alizarine (Dioxyanthraquinone)
Anthrapurpurine (Trioxyanthraquinone)
Flavopurpurine (Trioxyanthraquinone of another constitution).

These three dyestuffs by themselves or mixed in various proportions, represent commercial Alizarine, which is used in dyeing and printing in the form of a more or less thick brick red paste containing 20% and 40% dry colouring matter.

Alizarine paste contains only Alizarine and water. The dyestuff is suspended in a very finely divided state which ensures even-dyeing of the fibre. From a chemical point of view Alizarine is only very slightly soluble in water.

Alizarine paste may, as already mentioned, have a thick or thin consistency according to its manufacture. On adding a very small quantity of acid (sulphuric or hydrochloric acid, etc.) the paste becomes very thick, and on the other hand equally small quantities of alkalies render it perfectly liquid.

One can therefore draw no conclusion as to the amount of colouring matter present from the consistency of the paste; this can only be obtained by means of analysis.

Alizarine Red is used in a few cases in the dry state, in fine powder or in lumps (the latter having a concentration of 40, 50, 60, 70, and 80 °/o), but this refers exclusively to cotton-dyeing (Turkey-red).

The three above-mentioned dyestuffs: Alizarine, Anthrapurpurine, and Flavopurpurine, by themselves or mixed with each other, represent the following commercial brands which are used in the

Cotton and Silk Industry.

Alizarine V1 old (Alizarine)
» V2a blue shade
» V2a yellow shade
» V2
» V3
» GF
» GFX
» GFY
» GD (Anthrapurpurine)
» GG
» GI (Flavopurpurine)

and others, and the very beautiful and pure extra brands:—

Alizarine V1 new
» SX
» RA
» RG.

Alizarine V1 new is the bluest brand, the so-called "blue shade," whereas *GI* produces a yellowish red. The remaining brands dye intermediate shades.

Alizarine Red fixed with Turkey-red oil, lime, and alumina salts, serves in cotton-dyeing and printing for the production of the so-called Turkey-red, a colour which has been long known and highly appreciated on account of its extreme fastness to light and washing, and also for Steam red.

Very fast claret shades are obtained on a **chrome mordant**, and on an **iron mordant** a violet which has long been known and made use of.

The great success attained by artificial Alizarine in the cotton industry led the Badische Anilin- & Soda-Fabrik in 1878 to undertake the task of introducing these products for

Wool-Dyeing.

In the course of years they have succeeded more and more in obtaining acknowledgment of the merits of artificial Alizarine from the wool-dyers, though, partly owing to conservative views and partly to reasons of national economy trifling quantities of Madder are used even to this day.

The following brands are used in the wool industry:—

Alizarine Red WB paste (bluest shade)
» » WR paste (more reddish shade)
» » WG paste (more yellowish shade)
» » WGG paste (most yellowish shade).

Besides these paste brands there are also the powder brands, soluble in water (soda salts): —

Alizarine Red S WB powder = WB paste
» » S WR powder = WR paste
» » S WG powder = WG paste.

All these brands give bright red shades on an **alumina mordant,** which are similar to but clearer and faster to light than those got with Madder. On a **chrome mordant** they give brown shades which are largely used as self-colours and also in mixtures for browns, reds, etc.

Alizarine Red S powder (bluest brand) from Alizarine
» » SF powder (bluest brand) from Alizarine
» » SS powder (more reddish brand) from Anthrapurpurine
» » SSS powder (yellowish brand) from Flavopurpurine

are four brands used exclusively for wool-dyeing. They are soda salts of the sulphonic acids of Alizarine Red and were introduced into the market by the Badische Anilin- & Soda-Fabrik in 1885.

These dyestuffs give bright red shades on an **alumina mordant,** and blue to yellowish clarets on a **chrome mordant** which are more brilliant and clearer than those got with the corresponding paste brands. These brands are well adapted for "hearting" piece-goods and use in dyeing machines on account of their solubility in water.

Alizarine Red is used in **wool-printing** as well as **calico-printing** for cloth, slubbing (Vigoureux printing), and yarn. On **alumina mordant** it yields red and on **chrome mordant** claret-like shades of great fastness and beauty.

The great advantages of artificial Alizarine over Madder and other natural dyestuffs used in wool-dyeing, such as sanders-wood, camwood, etc., are as follows: —

Absence of all troublesome vegetable and woody particles which contaminate the wool, increasing the loss and making it less fit for spinning.

More reliable working owing to the composition and tinctorial value of artificial Alizarine always being the same.

Brighter and more beautiful shades.

Greater fastness.

Cheapness of colour.

Silk.

Alizarine Red is used for dyeing silk on alumina or chrome mordant respectively, to produce red and claret shades which are very fast to washing and light. Of course one can also print silk (cloth and yarn) with it.

Lakes.

Notable quantities of Alizarine Red is used in the manufacture of the so-called Madder lakes for lithographic printing, etc.

Purpurine.

Purpurine a trioxyanthraquinone is the constant companion of Alizarine in Madder. The Badische Anilin- & Soda-Fabrik commenced the manufacture of it in 1887 by oxidizing Alizarine. It is occasionally used, in the form of a reddish brown paste of 20 % colouring matter, in calico-printing on a **chrome** or **alumina mordant.**

Alizarine Orange.

Alizarine Orange or Nitro-Alizarine was discovered in 1875, and the Badische Anilin- & Soda-Fabrik commenced manufacturing it and placed it on the market in the following year. It is produced by the action of nitric acid on Alizarine (blue shade), and is supplied as a yellow paste of 15 %, 20 %, 30 %, and 40 % colouring matter.

Cotton.

Alizarine Orange A (yellowish shade)
» » D (reddish shade)

are used for dyeing and printing cotton. On **alumina mordant** Alizarine Orange yields reddish yellow (orange colour), and on **chrome mordant** reddish brown shades, which can be used as self-colours or for compound shades, for dyeing and printing cotton.

Wool-Dyeing.

Alizarine Orange was recommended in 1879 by the Badische Anilin- & Soda-Fabrik for this purpose, and the brands

Alizarine Orange W paste
» » S W powder (the soluble soda salt)

are used. It dyes **alumina**-mordanted wool orange, and **chrome**-mordanted wool reddish brown, and like Alizarine Red is a good substitute for the natural dyestuffs mentioned under that heading.

Alizarine Orange is also well adapted for printing **woollen cloth** and **slubbing** (Vigoureux).

Silk-Dyers and Printers

have in Alizarine Orange a valuable dyestuff for the production of fast orange yellow and reddish brown shades on alumina and chrome mordant respectively.

Lakes.

Alizarine Orange can also be employed for the manufacture of lakes.

Alizarine Maroon.

Alizarine Maroon was produced and introduced into commerce by the Badische Anilin- & Soda-Fabrik in the year 1885. It is a dark reddish brown paste used for dyeing and printing

Cotton

under the name of "Alizarine Maroon paste" which contains 20 % dry matter.

On **alumina mordant** it gives a bluish claret, which is very useful for shading Alizarine Red, and on a **chrome mordant** deep claret shades.

Wool-Dyeing and Printing.

Alizarine Maroon W paste
» » W powder

are used on **alumina mordant,** and occasionally on a chrome mordant, for shading Alizarine Red.

Silk.

Alizarine Maroon is suitable for dyeing and printing silk on an alumina and chrome mordant.

Alizarine Blue.

Just as Madder met with an adversary in Alizarine Red, so Indigo and Logwood, which have been known and applied in the textile industry for ages past encountered a powerful rival in the coal tar colour

Alizarine Blue.

The many advantages possessed by the artificial dyestuff, soon gave it a prominent position by the side of the natural products, and placed a series of new methods of application at the disposal of dyers and printers.

The manufacture of Alizarine Blue was commenced by the Badische Anilin- & Soda-Fabrik in 1878. It is obtained by heating *Alizarine Orange* (Nitro-Alizarine) with glycerine and sulphuric acid, and therefore its chemical nature must be regarded as Dioxyanthraquinone-quinoline.

It is a bluish grey paste containing 10% or 20% dry matter, insoluble in water, and like Alizarine Red possesses the property of assuming a thick consistency on addition of a small quantity of acid, and of being rendered equally liquid by small quantities of alkali.

Alizarine Blue possesses at the same time the nature of a weak acid and a weak alkali; with hydrochloric and sulphuric acids it forms chlorides and sulphates of Alizarine Blue, and with soda it forms the sodium salt of Alizarine Blue.

It combines with alkaline bisulphites; bisulphite of soda (briefly termed bisulphite) to form the soluble compound

Alizarine Blue S

which was discovered and placed on the market by the Badische Anilin- & Soda-Fabrik in 1881. It was the introduction of this soluble compound that opened the way for Alizarine Blue into calico-printing and caused it to be more generally applied.

After standing for some time in aqueous solution this bisulphite compound decomposes into its original components and especially when heated to about 140° F.; a behaviour which must be considered when dyeing or printing with this colour.

For Cotton

the following insoluble paste brands are used, but only on a **chrome mordant**:—

Alizarine Blue X 10% and 20%
" " XA 20% (soda salt)
" " R 10% and 20% (for darker shades)

as well as the soluble bisulphite compounds:—

Alizarine Blue S paste
" " S powder *brown paste or*
" " SR paste *powder respectively.*
" " SR powder

The object of this method is to only partially dye the slubbing, and then blend the partly dyed and partly undyed fibres by a carding operation. By this method, a more intimate and uniform mixture is obtained than by mixing white and dyed wool together.

Lighter and darker shades are obtained by altering the printing pattern, which consists of stripes of different width, or by varying the quantities of dyestuff in the printing colour.

Slubbing, which as a rule is very clean, can be chlored before printing, but this is not absolutely necessary and must often be dispensed with, as it considerably impairs the fitness of the wool for felting.

British gum or dextrine are used as thickenings, as they can easily be removed from the slubbing by washing.

The printing is done on a special machine, Vigoureux system (the inventor's name) on which the slubbing is combed out to a suitable width, and then passed between a colour and a pressing roller when it absorbs the printing colour from the parts of the former which stand out in relief.

After printing the slubbing is not dried, but at once steamed in the same manner as was described for cotton. It is then washed in a lisseuse first in clean water, and afterwards with a weak soap solution.

The slubbing which has been thus printed is then carded, and so worked up into a mixture which is spun into yarn and mostly used for the manufacture of dress-goods.

The Alizarine Colours have proved to be extremely useful for this special kind of work, on account of being very fast to milling and light, and their application is continually increasing.

The printing of woollen yarn

is being practised in an increasing degree for producing certain effects on woollen goods, are is carried out exactly as described above.

All the Alizarine Colours are adapted for wool-printing, but of Alizarine Black only the *S* and *SR paste* marks are suitable.

At the present time Alizarine Blue is decidedly cheaper than indigo. Logwood, another natural dyestuff largely used to produce blue shades, is much surpassed by Alizarine Blue as regards fastness to light and acids. Another important advantage possessed by Alizarine Blue over Logwood is the absence of wood particles, etc. Logwood must be boiled out, whereas Alizarine Blue is added direct to the dye-bath. By using ground Logwood the wool is rendered impure, its fitness for spinning impaired, and the loss increased. Alizarine Blue possesses great advantage over Logwood with regard to evenness and reliability in dyeing, as Logwood constantly varies in quality, shade, and purity. However, the higher price of the coal tar dye, does not in all instances allow of substituting it for the natural dye.

Silk.

In silk-dyeing and printing Alizarine Blue furnishes blue shades, fast to light and washing.

Colour Lakes.

It can also be used in the manufacture of fast blue lakes.

Patent Alizarine Indigo Blue.

This dye is produced by the action of fuming sulphuric acid on Alizarine Blue, and its manufacture was begun by the Badische Anilin- & Soda-Fabrik in 1888. It is supplied as a soluble bisulphite compound, in the form of a thick reddish brown paste or as a black soluble powder (sodium salt) and is only dyed on a chrome mordant.

Its chemical and dyeing properties correspond entirely to those of the bisulphite compound of Alizarine Blue.

Cotton.

Alizarine Indigo Blue S paste (bisulphite compound)

serves for dyeing and printing cotton greenish blue shades which are fast to light and washing, either alone or in combination with Alizarine Blue.

Wool.

The following soluble brands are used for dyeing wool fast greenish blue shades.

Alizarine Indigo Blue S W paste (bisulphite compound)
» » » S W powder (soda salt)
» » » S M W paste (bisulphite compound)
» » » S M W powder (soda salt).

It is also used for printing **woollen cloth, slubbing** (Vigoureux), and **yarn.**

Silk.

Alizarine Indigo Blue S paste is adapted for dyeing and printing silk fast greenish blue shades.

Colour Lakes.

It can also be used in the manufacture of fast blue lakes.

Patent Alizarine Green.

The Badische Anilin- & Soda-Fabrik discovered and commenced to manufacture this colour in 1888. It is produced like Alizarine Indigo Blue by the action of fuming sulphuric acid upon Alizarine Blue, and is supplied as a soluble bisulphite compound in the form of a yellowish brown thick paste which has the same properties as Alizarine Blue S, or as a black powder (soda salt).

It is always fixed by means of a chrome mordant.

Cotton.

Alizarine Green S paste (bisulphite compound)

is well adapted for dyeing or printing cotton cloth, or yarn bluish green shades which are fast to light and washing.

Wool.

Alizarine Green SW paste (bisulphite compound)
» » SW powder (soda salt)

serve for dyeing wool fast bluish green shades, and can be applied with advantage for shading Alizarine Blue and Alizarine Indigo Blue.

It is also a suitable colour for **printing wool.**

Silk.

Alizarine Green is useful for the production of bluish green shades, which are fast to light and washing.

Colour Lakes.

It can also be used for the manufacture of fast bluish green lakes.

Patent Anthracene Blue.

Under this heading the Badische Anilin- & Soda-Fabrik placed a number of blue dyestuffs on the market, in the year 1891, which are produced by the action of fuming sulphuric acid on dinitroanthraquinone. They are supplied in the form of brown to black pastes of greater or less consistency, which mostly contain 10 % colouring matter, as well as soluble powders (soda salts).

They are chiefly fixed on a chrome mordant, and occasionally on an alumina mordant.

Cotton.

Anthracene Blue RR paste
» » R »
» » B »
» » G extra paste
» » GG paste
» » G »
» » SRR powder
» » SR »
» » SB »
» » SG extra powder
» » SGG powder
» » SG powder

are used to a certain extent for shading Alizarine Red on **alumina mordant** towards claret, for dyeing cotton on a **chrome mordant,** and also for **calico** and **yarn-printing.**

Wool.

The Anthracene Blue brands are very important for dyeing wool blue shades fast to light and milling, which is required for the manufacture of cloth.

They are chiefly dyed on a chrome mordant, and only in a few cases are used for shading Alizarine Red on an alumina mordant.

The following brands are used: —

Anthracene Blue WRR paste
» » WRR extra paste
» » WR paste
» » WB paste
» » WG extra paste
» » WGG paste
» » WG paste
» » SWRR powder
» » SWRR extra powder
» » SWR powder
» » SWB powder
» » SWG extra powder
» » SWGG powder
» » SWG powder.

The brands *WRR* and *SWRR* give a reddish, and *WG* a greenish blue, and the other brands range between these two.

Anthracene Blue WN paste
» » SWN powder
Anthracene Dark Blue W paste
» » » SW powder

are especially adapted for darker full shades and

Anthracene Blue SWX powder
» » SWX extra powder

for piece-dyeing.

Shades obtained with the various brands of Anthracene Blue, with regard to fastness resemble those got with Alizarine Blue, but are not quite so fast to acids.

Anthracene Blue is considerably cheaper than Alizarine Blue and admits of a still more successful opposition against indigo, with, or without a topping of logwood.

It can also be used to advantage for printing **woollen cloth, slubbing,** and **yarn.**

Silk.

The Anthracene Blues are adapted for dyeing and printing silk fast blue shades.

Colour Lakes.

They are also suitable for the manufacture of lakes.

Anthracene Brown.

This dyestuff was discovered in 1877 by *Seuberlich,* by the action of sulphuric acid on a mixture of gallic and benzoic acids. The Badische Anilin- & Soda-Fabrik recognised its value for the dyeing industry, and commenced to manufacture it in 1886, and placed it on the market as an insoluble brown paste containing 20 % and 40 % colouring matter, and as a black soluble powder (soda salt).

Cotton.

Anthracene Brown paste 20 % and 40 %

serves for dyeing and printing cotton fast brown shades, on **alumina,** or **chrome mordants** (also on an iron mordant) as well as for compound colours.

Wool.

The following are the best brands adapted for dyeing wool:—

Anthracene Brown W paste 20 % and 40 %
» » S W powder (soda salt)
» » W R paste (reddish brand)
» » S W R powder (soda salt)
» » W G paste (yellowish brand)
» » W G G paste (yellowest brand).

Anthracene Brown yields on a **chrome mordant** brown shades which are very fast to light and milling and possess all the advantages over the natural dyes which have been mentioned with Alizarine Red.

It is also a suitable colour for **wool-printing.**

Silk.

Anthracene Brown serves for dyeing or printing fast brown shades on silk, with a **chrome,** or an **alumina mordant.**

Colour Lakes.

It can also be used for the manufacture of fast brown lakes.

Galleïne.

By its chemical formation Galleïne belongs to the phthalic acid colouring matters or eosines, but on account of its fastness and dyeing properties, may be regarded as a connecting link with the Alizarine Colours.

It was discovered in 1871 by Professor *von Baeyer,* by the action of pyrogallol on phthalic anhydride, and the Badische Anilin- & Soda-Fabrik commenced manufacturing it in 1878. It is used for dyeing in the form of a dark red brown paste, as a powder soluble in water (soda salt), and one only slightly soluble in water.

Cotton.

Galleïne paste 10 % and 20 %

serves for the production of violet shades on a **chrome mordant.**

Wool.

This dyestuff is more important for wool, and was recommended by the Badische Anilin- & Soda-Fabrik in 1880 for this purpose. Wool mordanted with chrome is dyed with the brands

Galleïne W paste 10 % and 20 %
WR » 20 % « 40 %
» W powder
» SW » (soluble soda salt)

which give fast reddish violet shades.

In combination with logwood, Galleïne gives comparatively fast and cheap dyeings, in opposition to the so-called wood blues.

Silk.

Galleïne is used with advantage for dyeing and printing silk on alumina and chrome mordants.

Colour Lakes.

It can also be used for the manufacture of violet lakes.

Coeruleïne.

This dyestuff was discovered by Professor *von Baeyer* in 1871, by the action of sulphuric acid on Galleïne, and the Badische Anilin- & Soda-Fabrik commenced to manufacture it in the year 1878, and placed it on the market in the form of a black insoluble paste. The insoluble Coeruleïne combines like Alizarine Blue with alkaline bisulphites (bisulphite of soda), to form the soluble *Coeruleïne S,* which is supplied to the dyer in the form of a greenish black paste, and as a black powder.

Cotton.

Coeruleïne is used in cotton-dyeing and printing, with **chrome** or **alumina mordant**, for fast olive green shades, and the following brands are supplied for this purpose.

Coeruleïne II
» I
» S paste } *bisulphite brands.*
» S powder }

Wool.

Coeruleïne was recommended by the Badische Anilin- & Soda-Fabrik for wool-dyeing in 1880.

Coeruleïne W
» SW paste } *bisulphite brands*
» SW powder }

give olive green shades on a **chrome mordant.** It is suitable in a high degree for the production of fast green and compound shades.

Silk.

It is also suitable for the production of fast green or compound shades on silk on a chrome or alumina mordant.

Colour Lakes.

It is also useful for the manufacture of fast green alumina lakes.

Patent Galloflavine.

Galloflavine was produced by the Badische Anilin- & Soda-Fabrik in 1886, by oxidation of gallic acid in an alkaline solution, and was brought on the market in the same year as a yellow paste containing 10 % colouring matter.

Cotton.

Galloflavine paste

serves for dyeing and printing cotton on a **chrome mordant** greenish yellow or compound shades.

Wool.

Galloflavine W paste
» *W powder*

are used for dyeing wool yellow or compound shades on a chrome mordant. It dyes very even shades, and on this account has rapidly found favour in hat-dyeing.

Silk.

It is also a useful colour for dyeing and printing silk.

Alizarine Black.

This colouring matter has already been long known under the name of Naphthazarine. It was discovered in 1861 by *Roussin,* by reduction of dinitronaphthaline.

The Badische Anilin- & Soda-Fabrik recognised its value for the textile industry, and in 1887 commenced its manufacture on a large scale. In the same year this company discovered and patented the soluble bisulphite compounds of Alizarine Black; i. e. *Alizarine Black S* and *SR paste,* which are specially adapted for printing purposes.

Alizarine Black is supplied as a black brown paste or a black powder, both of which are only slightly soluble in water, as well as a soluble blackish olive-coloured paste i. e. *Alizarine Black S* and *SR paste*, which are bisulphite compounds. These were followed in 1897 by the bluer brand *Alizarine Black SRA paste.*

Cotton.

Alizarine Black R paste
» » *R powder*

are recommended for dyeing cotton but they are not suitable for printing, for which purpose the patent soluble bisulphite brands

Patent Alizarine Black S paste
» » » SR »
» » » SRA »

are used. It is fixed on a **chrome mordant** and yields a black which is very fast to light and washing. It also serves to produce grey and compound colours, in calico and yarn-printing.

Wool.

Alizarine Black is of very great importance in wool dyeing, as it gives a black which is very fast to light, milling, and acids, and on account of these good properties its consumption in the wool industry is steadily increasing.

It is a successful rival to the fugitive logwood, and it is only on account of the higher price of Alizarine Black that logwood has not yet shared the fate of other natural dyestuffs.

The fastness to light of Alizarine Black surpasses that of the best logwood; its fastness to milling is excellent, and satisfies the highest requirements.

It is so fast to acids that it can be carbonized with sulphuric acid, which as is well-known, logwood does not resist. A further important advantage which Alizarine Black possesses over logwood, is the purity of the dye, and the total absence of wood particles, which in the case of logwood render the wool impure, and thus increase the loss and waste in spinning.

Finally, Alizarine Black is much more reliable in dyeing than logwood, which varies in shade according to its origin and quality.

The following brands are used for dyeing **wool** on a chrome mordant:—

Alizarine Black WR paste (reddish black)
» » WR powder (reddish black)
» » SRW paste (deeper black)
» » SRW powder (deeper black)
» » SW paste (bluish black)
» » SW powder (bluish black)
Alizarine Blue Black SW paste (blue black)
» » » SW powder (blue black)
» » » W paste (blue black)
» » » W powder (blue black).

For printing on **woollen cloth, slubbing,** or **yarn** only

Patent Alizarine Black S paste
» » » SR »

are recommended, as the remaining brands are unsuitable for this purpose.

Silk.

The same brands used for wool dyeing serve also for dyeing silk, but for printing, only the following are suitable:—

Patent Alizarine Black S paste
» » » SR »

Colour Lakes.

It is also useful in the manufacture of lakes.

Patent Alizarine Yellow.

Under this heading, two new dyestuffs were introduced into the market in 1889, which had been discovered by the Badische Anilin- & Soda-Fabrik, i. e.

Alizarine Yellow A

which is obtained from pyrogallol and benzotrichloride, and

Alizarine Yellow C

from pyrogallol and acetic acid.

They are employed as slightly brownish-coloured pastes, containing 20 % colouring matter on alumina mordant for the production of yellow shades on cotton. *Alizarine Yellow A* giving an orange yellow, and *Alizarine Yellow C* a lemon yellow shade.

These colours are not adapted for wool and silk.

The following colours do not strictly speaking belong to the class of Alizarine dyes, but on account of their good properties as regards fastness, and also being dyed on mordants may be very well annexed to them.

Patent Carbazole Yellow.

The Badische Anilin- & Soda-Fabrik discovered this dye and commenced to manufacture it on a large scale in 1889. It is produced as a yellowish brown powder by the combination of salicylic acid with diamidocarbazol, and belongs to the class of substantive azo-dyes. It is, however, distinguished from many members of this group by the fact that it yields very fast yellow shades on a **chrome mordant.**

Cotton.

It is used for dyeing cotton direct (with Glauber's salt, etc.) or for dyeing and printing cotton on a chrome mordant.

Wool.

Carbazole Yellow W

is used in wool dyeing on a chrome mordant to produce yellow shades which are fast to light and washing, and for compound colours.

It is also useful for wool printing.

Silk.

Carbazole Yellow W is employed for dyeing and printing silk full and fast yellow shades.

Wool Yellow.

This colour is obtained by the action of diazotized aniline on fustic extract. The Badische Anilin- & Soda-Fabrik commenced to manufacture it on a large scale in 1890, and placed it on the market in the form of a slightly soluble yellowish red paste. Wool Yellow fixed on a **chrome mordant** serves exclusively for dyeing wool, and is a good substitute for fustic, quercitron, etc. but is of no importance for **cotton** and **silk.**

Mordant Yellow.

This product is like Carbazole Yellow an azo-dyestuff, and gives yellow shades on a **chrome mordant** which are fast to milling and light. It was introduced in 1893 by the Badische Anilin- & Soda-Fabrik, and recommended for dyeing wool under the name of

Mordant Yellow G.

This was followed in 1896 by a more reddish brand

Mordant Yellow R.

In 1898 the brand

Fast Mordant Yellow G

was placed on the market. The shade lies between those of Mordant Yellow G and R, but is distinguished from these by being faster to milling.

These dyestuffs are especially useful for **wool-dyeing,** but can also be employed for **cotton** and **silk.**

Mordants and Chemicals.

Lime Salts.

Caustic lime, quicklime, CaO, slaked with water, gives milk of lime $Ca(OH)_2$ which is used in the production of acetate of lime, and as an addition to the dye-bath in Turkey-red dyeing when the water is too soft.

Carbonate of lime, chalk, whitening, $CaCO_3$, is a very fine white powder, insoluble in water, which is used in dyeing and printing Turkey-red to fix the alumina (chalking).

Acetate of lime, $Ca(C_2H_3O_2)_2$, is a white or grey salt which is very soluble in water. It is used in printing Alizarine Colours on cotton, wool, and silk, and dyeing wool with Alizarine Red on an alumina mordant, and cotton on a chrome mordant.

For this purpose a solution of 15° Tw. is prepared by dissolving

2 lbs. solid acetate of lime in
1 gall. water

or according to the following recipe: —

3 lbs. quicklime are well slaked with
$1^1/_2$ gall. water; then add
21 lbs. acetic acid 9° Tw. (30%)
$1^1/_2$ gall. water

and adjust the solution to shew 15° Tw.

Acetate of lime must be free from iron.

Hypochlorite of lime, bleaching powder, $Ca\begin{cases} Cl \\ OCl \end{cases}$, is a white powder smelling of chlorine which is used for bleaching cotton and chloring wool which has to be printed with the Alizarine Colours, and to obtain a silky "handle" and gloss. A solution of $1^1/_2$° Tw. is generally used which is prepared as follows: —

4 lbs. bleaching powder

are well ground in a suitable vessel with

1 gall. water;

when the paste is uniform add further

$1^1/_4$ gall. water,

stir well, and allow the white precipitate to settle down. Decant the clear liquid and adjust to $1^1/_2$° Tw. by addition of water.

Alumina Salts.

Hydrate of alumina, $Al_2(OH)_6$, is used for preparing soluble alumina salts.

Acetate of alumina, is prepared by the action of sulphate of alumina on sugar of lead or by dissolving hydrate of alumina in acetic acid.

It has the formula, $Al_2(C_2H_3O_2)_6$, and is formed when

6 oz. sugar of lead ($Pb(C_2H_3O_2)_2+3H_2O$) are treated with
3 » sulphate of alumina
($Al_2(SO_4)_3+12H_2O$ (which contains 18% Al_2O_3).

This normal acetate, however, decomposes on standing in aqueous solution and for this reason is not suitable for dyeing purposes.

For this

sulphate acetate of alumina

is used which is also obtained by the action of sulphate of alumina on sugar of lead. According to the quantity of sugar of lead used a compound of alumina results which contains more or less acetic acid in place of sulphuric acid. The compound

$$Al_2(SO_4)_2(C_2H_3O_2)_2,$$

in which 1 part of sulphuric acid has been replaced by two parts of acetic acid is produced from

2 oz. sugar of lead
3 » sulphate of alumina

whilst the salt

$$Al_2SO_4(C_2H_3O_2)_4$$

in which 2 parts of sulphuric acid are replaced by 4 parts of acetic acid is got by mixing

4 oz. sugar of lead
3 » sulphate of alumina.

Of course, these compounds can be got by dissolving alumina in the corresponding quantity of acetic and sulphuric acid.

Sulphate acetate of alumina is used in Turkey-red dyeing and calico-printing, and a suitable mordant can be prepared as follows: —

Dissolve separately

16 lbs. sugar of lead in
1½ gall. boiling water

and

18 lbs. sulphate of alumina
(free from iron and having 12 molecules of water of crystallisation, and containing 18% Al_2O_3)

in 1½ gall. boiling water.

Mix the hot solutions and pour off the clear liquid from the precipitate. The white precipitate of sulphate of lead is washed with water and the wash water used for adjusting the acetate of alumina solution to shew 15° Tw. or 9° Tw. respectively. If the solution is not quite clear, it must be filtered.

Sulphate of alumina, $Al_2(SO_4)_3+12H_2O$, is a white crystalline salt which is readily soluble in water. The commercial sulphate of alumina contains 12 molecules = 38% water and 18% Al_2O_3, and should be free from iron. It is used as a mordant in Turkey-red dyeing and for the preparation of acetate of alumina.

When used for Turkey-red it is treated with soda, and so rendered more or less basic according to the quantity of soda used.

A suitable mordant for this purpose can be prepared as follows:

Dissolve

80 lbs. sulphate of alumina (commercial quality with 12 molecules of water and 18 % Al_2O_3) in
50 gall. hot water, and also
10 lbs. soda ash in
5 gall. hot water.

Add the soda solution gradually while stirring to the sulphate of soda solution, and then dilute down with water to 9° Tw.

Sulphocyanide of alumina 32° Tw., $Al_2(CNS)_6$, is used in aqueous solution as a mordant in printing Alizarine Red, etc. on cotton, wool, and silk.

This mordant is prepared by dissolving

6 lbs. 10 oz. sulphate of alumina (commercial quality with 12 molecules of water and 18 % Al_2O_3) in
$^1/_2$ gall. water, and
9 lbs. sulphocyanide of barium crystals in
$^1/_2$ gall. water

at a temperature of about 140° F. Mix the two solutions and pour the liquid from the white precipitate of barium, filter if necessary and dilute to 32° Tw.

Aluminate of soda, $Al_2Na_2O_4$, is a white crystalline solid soluble in water, and is used for mordanting cotton to be dyed with Alizarine Red.

Alum, potash alum, $K_2Al_2(SO_4)_4 + 24\,H_2O$, exists as a white powder or colourless crystals. Formerly it was exclusively used for mordanting purposes and for the preparation of other alumina mordants, whereas at present the cheaper sulphate of alumina which is now produced sufficiently pure is employed for these purposes.

Alum is, however, still used as a mordant for dyeing wool and silk with Alizarine Colours.

Chloride of alumina, Al_2Cl_6, is used in aqueous solution for carbonizing woollen cloths dyed with colours that are sensitive to acids.

Chrome Salts.

Chrome alum, $K_2Cr_2(SO_4)_4 + 24\,H_2O$, exists as large violet crystals which are readily soluble in water. It is employed in the preparation of other chrome mordants, but by itself it is only little used as a mordant in wool-dyeing.

Acetate of chrome, is found on the market as a basic salt having the formula $Cr_2(OH)_2(C_2H_3O_2)_4$ in solution as

Acetate of chrome 32° Tw.,

and in the solid state as

Acetate of chrome dry,

and also as a neutral salt with the formula $Cr_2(C_2H_3O_2)_6$, in solution as

Green acetate of chrome 39° Tw.

It is used as a mordant in printing Alizarine Colours, and also to a moderate extent in cotton, wool, and silk-dyeing.

Chloride of chrome, 32° Tw. and 52° Tw., $Cr_2Cl_2(OH)_4$, is a basic product which is used in the form of a green solution as a mordant in dyeing cotton and silk with Alizarine Colours.

Sulphocyanide of chrome, 32° Tw., $Cr_2(CNS)_6$, a green solution, is used to a limited extent as a mordant in printing Alizarine Colours on silk.

Bisulphite of chrome, 48° Tw. and 34° Tw., is a green solution employed in cotton-dyeing and calico-printing as a mordant which is easy to discharge.

Bichromate of potash, $K_2Cr_2O_7$, yellowish red crystals readily soluble in water, is extensively employed as a mordant for wool in dyeing with Alizarine Colours.

Bichromate of soda, $Na_2Cr_2O_7 + 2H_2O$, is a yellowish red crystalline hygroscopic product, which answers the same purpose and produces effects like bichromate of potash, but is cheaper.

Fluoride of chrome, $Cr_2\left\{\begin{matrix}(OH)_2\\ Fl_4\end{matrix}\right.$, is a green powder soluble in water, which is used as a mordant in dyeing wool with Alizarine Colours.

Iron Salts.

Acetate of iron, $Fe(C_2H_3O_2)_2$, pyrolignite of iron, is sold as a solution used as a mordant for dyeing and printing cotton violet with Alizarine.

Nitrate of iron, a brown solution which was formerly prepared by treating green vitriol with nitric acid; it is a basic sulphate of iron, and is used as a mordant for dyeing silk with Alizarine Black.

Ferricyanide of potassium, $K_6Fe_2Cy_{12}$, red prussiate of potash, brownish red crystals, is used for discharging Alizarine Colours on cotton.

Ferrocyanide of potassium, $K_4Fe_2Cy_6 + 3H_2O$, yellow prussiate of potash, yellow crystals, is often used as an iron mordant in calico-printing.

Chloride of iron, Fe_2Cl_6, is a brown solution which serves for developing indigo from Indophor.

Copper Salts.

Sulphate of copper, $CuSO_4 + 5H_2O$, blue crystals, soluble in water.

Tin Salts.

Tin salt, $SnCl_2 + 2H_2O$, stannous chloride, white crystals soluble in water, is employed in brightening Turkey-red dyeings.

Chloride of tin, $SnCl_4$, stannic chloride, is used for preparing oxalate of tin and for weighting silk.

Pink salt, $SnCl_4 + 2NH_4Cl$, is a double salt of stannic and ammonium chlorides. It occurs as white crystals and is also used for weighting silk.

Stannate of soda, Na_2SnO_3, known as preparing salt, is likewise used for weighting silk.

Oxalate of tin, 25° Tw., mordant OX, is a colourless solution used in printing Alizarine Colours on cotton, wool, and silk, and is prepared as follows:—

Dissolve

1 lb. chloride of tin (solid) in
2½ gall. water; also
13 oz. soda crystals in
2½ gall. water.

Pour these two solutions together and well wash the white precipitate by decantation until red litmus paper dipped in the water no longer turns blue.

The precipitate containing about 12 % dry matter and weighing about 4½ lbs. is mixed with

3 oz. oxalic acid crystals,

and dissolved by heating to about 175° F. on a water-bath. Finally dilute down till the solution stands at 25° Tw.

Zinc Salts.

Bisulphite of zinc, 32° Tw., $Zn(HSO_3)_2$, is used to a limited extent in printing Alizarine Blue on cotton.

Nickel Salts.

Sulphate of nickel, $NiSO_4 + 7H_2O$, occurs as green crystals soluble in water which are used in preparing acetate of nickel.

Acetate of nickel, $Ni(C_2H_3O_2)_2$, green crystals, is used as a solution of 15° Tw. in printing cotton with Alizarine Blue.

Lead Salts.

Acetate of lead, sugar of lead, $Pb(C_2H_3O_2)_2$, occurs as white soluble crystals which are used in the preparation of acetate of alumina and other acetates.

Ammonia Salts.

Ammonia, caustic ammonia, liquor ammoniac NH_4OH, is a strongly smelling caustic fluid used for cleansing wool and neutralizing the bath when dyeing Alizarine Colours on wool. It is also used as an addition to the Turkey-red oil bath in dyeing cotton with Alizarine.

Carbonate of ammonia, $NH_4HCO_3 + NH_4CO_2NH_2$, exists as white crystals smelling of ammonia which can also be used for cleansing wool.

Acetate of ammonia, $(NH_4)C_2H_3O_2$, an aqueous solution smelling of ammonia. It is used in woollen yarn and cloth dyeing to produce better penetration and evenness of shade. It was recommended for this purpose in 1888 by the Badische Anilin- & Soda-Fabrik.

Sal-ammoniac, chloride of ammonia, NH_4Cl, occurs as a white crystalline powder or white cakes which are readily soluble in water. It is used as a fixing agent in dyeing Alizarine Red on aluminate of soda mordant.

Ammonium sulphocyanide, NH_4CNS, colourless hygroscopic crystals, readily soluble in water. It serves to prevent the entrance of injurious matter when dyeing with Alizarine Colours in a bright copper-bath.

Soda Salts.

Caustic soda, $NaOH$, occurs as white corrosive lumps and is readily soluble in water. Its solution is known as

Soda-lye, and is employed for boiling off cotton previous to mordanting; as a discharge for Turkey-red, and for the preparation of alkaline chrome mordant for cotton.

Soda, calcined soda, soda ash, Solvay soda, ammonia soda (carbonate of soda) Na_2CO_3, is a white soluble powder used for cleaning and washing cotton and wool.

Soda crystals, soda which contains water, $Na_2CO_3 + 10H_2O$. It exists as colourless, soluble crystals which effloresce when exposed to air, and is employed for the same purposes as soda ash; one part of ash corresponding to 2·7 parts of crystals.

Borax, borate of soda, $Na_2B_4O_7 + 10H_2O$, occurs as a white powder soluble in water and used in printing cotton with Indophor.

Silicate of soda, $Na_2Si_4O_9$, is supplied as a clear aqueous solution and serves as a fixing agent in silk-dyeing, for alumina and chrome mordants.

Bicarbonate of soda, $NaHCO_3$, is a white soluble powder, also used for fixing alumina and chrome mordants in silk-dyeing.

Sodium sulphide, $Na_2S + 9H_2O$, occurs as colourless or brownish crystalline lumps which are readily soluble in water and very corrosive. It is used for dyeing cotton with Fast Black.

Bisulphate of soda, $NaHSO_4$, white soluble lumps which are used in mordanting wool as a cheap substitute for tartar, and also for fixing the acid Aniline dyes which are used in conjunction with the Alizarine Colours.

Glauber's salts, sulphate of soda, $Na_2SO_4 + 10H_2O$, exist as small white soluble crystals employed for producing level shades of Aniline Colours on wool.

Chlorate of soda, $NaClO_3$, white soluble crystals used for discharging Alizarine Colours.

Bisulphite of soda, $NaHSO_3$, is used for bleaching wool and rendering Alizarine Colours soluble, and is supplied as an aqueous solution 77° Tw.

Hypochlorite of soda, $NaOCl$, is obtained by mixing solutions of bleaching powder and soda and is a good substitute for bleaching powder in chloring wool.

A solution of $1^1/_2$° Tw. is used for this purpose and is obtained as follows: — Grind up

10 lbs. bleaching powder

in a suitable vessel with

$2^1/_2$ gall. water;

then add while stirring

2 quarts, $1^1/_2$ pints soda solution
(got by dissolving 1 lb. calcined soda
in 1 gall. water).

Further add

3 gall. water

to this paste, stir well, and allow the white precipitate to settle down. Pour off the clear liquid and dilute with water to $1^1/_2$° Tw.

Potash Salts.

Chlorate of potash, $KClO_3$, occurs in the form of white soluble crystals used for discharging Alizarine Colours.

Bromate of potash, $KBrO_3$, is a difficultly soluble, white powder, and is also used for discharging Alizarine Colours.

Tartar, bitartrate of potash, $KH_5C_4O_6$, see under acids.

Lactoline, $KH_{11}C_6O_6$, potassium acid lactate, see under acids.

Barium Salts.

Sulphocyanide of barium, $Ba(CNS)_2$, occurs as white crystals used in the preparation of sulphocyanide of alumina and sulphocyanide of chrome.

Magnesium Salts.

Carbonate of magnesia, $MgCO_3$, is used in discharging Alizarine Colours on cotton cloth.

Chloride of magnesia, $MgCl_2 + 6H_2O$, is used for carbonizing wool.

Acids.

Acetic acid, 9° Tw. (30%), $C_2H_4O_2$, a colourless liquid, is added to the printing colour in cotton, wool, and silk-printing to prevent the premature formation of the colour lake. It is also used for correcting water for dyeing cotton, wool, and silk with Alizarine Colours, and for brightening silk-dyeings.

Sulphuric acid, 168° Tw., H_2SO_4, is a heavy strongly corrosive fluid used as a cheap substitute for tartar in mordanting wool. It is also employed along with bisulphite of soda for bleaching wool, and along with Glauber's salts for dyeing Aniline Colours.

It is useful for stripping shoddy and for carbonizing wool.

Hydrochloric acid, HCl, occurs as a strongly acid aqueous solution used to acidify baths of bleaching powder and hypochlorite of soda for bleaching cotton and chloring wool.

Nitric acid, HNO_3, is also used in some cases for stripping shoddy.

Tartaric acid, $C_4H_6O_6$, exists as colourless soluble crystals which are used for discharging Alizarine Colours on cotton, and for printing on wool.

Citric acid, $C_6H_8O_7 + H_2O$, is used for the same purpose as tartaric acid and occurs as colourless soluble crystals.

Oxalic acid, $C_2H_2O_4 + 2H_2O$, white crystals soluble in water, is a cheap substitute for tartar in mordanting wool with bichromate of potash. It is also useful for stripping shoddy, etc.

Lactic acid, 50%, $C_3H_6O_3$, is manufactured by C. H. BOEHRINGER SOHN, Nieder-Ingelheim, as a thick brownish fluid and has been lately recommended as an addition to the bichromate of potash-bath used for mordanting wool in place of tartar.

Tartar, bitartrate of potash, $KH_5C_4O_6$, is according to the degree of purity, a white to grey powder rather difficult to dissolve in water, and is used as an addition to the bichromate of potash-bath used for mordanting wool.

Lactoline, potassium acid lactate, $KH_{11}C_6O_6$, can be had in the form of a 50% thick solution (C. H. BOEHRINGER SOHN, Nieder-Ingelheim). It is used in combination with chrome in place of tartar in wool-dyeing.

Tanning Materials.

Tannic acid, tannin, is a light brown powder readily soluble in water.

Sumac leaves, occurs as yellowish brown light leaves.

Sumac extract, is a thick brown liquid.

Myrobalans,

Gall nuts,

Divi-divi, etc.

are materials which contain tannic acid and are used for mordanting cotton with chloride of chrome for very dark shades.

Thickening Materials.

Gum arabic, is readily soluble in water and serves as a thickening agent especially for light shades in calico and silk-printing.

Wheat starch, is used for printing cotton, wool, and silk for medium and darker shades.

British gum, serves especially for the preparation of thickenings used in slubbing-printing.

Dextrine, is a readily soluble powder also used as a thickening agent.

Wheat flour, is particularly suited for printing on linen cloth.

Dark burnt starch, and

Light burnt starch, are used for special purposes in calico-printing.

Gum tragacanth, is useful as an addition to starch thickenings in calico-printing.

Soaps, Oils, etc.

Bar soap, soda soap, olive oil soap, Marseilles soap, is soluble in water with which it forms a froth. It is used in large quantities for washing, cleansing, and milling dyed and undyed textile materials. It must be quite neutral, i. e. it must not contain any free alkali, nor any unsaponified fat which is insoluble in water.

Soft soap, or potash soap, has a stronger action than soda soap, and is used in a few cases in the wool industry.

"Boiled-off" liquor, is the soap solution which has been used for washing the gum out of raw silk. It is also used as an addition to the bath in silk-dyeing.

Olive oil, is used as an addition to the thickenings for printing Alizarine Colours and for preparing cotton in the Turkey-red process.

Tournant oil, is olive oil which has become rancid and is used in the old Turkey-red dyeing process.

Castor oil, is used in the preparation of Turkey-red oil.

Turkey-red oil, Alizarine oil, is a more or less clear liquid which dissolves in water but renders it turbid.

The various qualities are mostly prepared by the action of sulphuric acid or soda-lye upon castor oil and rarely upon olive or other oils.

On treating castor oil with sulphuric acid, glycerine, and sulphuric ethers of ricinoleïc acid are obtained; the so-called sulpholeates (Turkey-red oil F). They are used to prepare cotton for the new red process (Turkey-red), and for Alizarine Colours on chrome-mordanted cotton.

The product obtained by treating castor oil with soda-lye (Turkey-red oil D) is ricinoleate of soda, and is used for preparing cloth for calico-printing.

Glycerine, is a thick liquid as clear as water and used in wool-printing and for preparing alkaline chrome mordant.

Water.

WATER plays a very important part in dyeing and in the textile industry generally. It is a well-known fact to dyers that the same results cannot be obtained at all places with the artificial and still less so with the natural dyestuffs, although dyed under exactly the same circumstances. The explanation for this is often only to be found in the different nature of the water at the disposal of the dyer. The water of brooks, rivers, wells, etc., always contains more or less lime or magnesia salts according to the nature of the strata through which it has passed.

Water coming from primeval rock, such as sandstone, does not contain much lime, but water from calcareous and dolomite mountains contains considerable quantities.

Lime exists in water chiefly in two forms,

1) bicarbonate of lime
2) sulphate of lime.

Bicarbonate of lime is a compound of carbonate of lime which occurs as limestone, chalk, etc., with carbonic acid. Water alone does not dissolve carbonate of lime but does so quite easily in the presence of carbonic acid, which occurs in nature as the result of the charring or putrefying of organic substances. It is contained to a greater or lesser extent in almost every water, enabling it to dissolve carbonate of lime as it passes through the rocks.

On the other hand, sulphate of lime is soluble to a certain extent in pure water, so that water passing through layers of soil containing gypsum dissolve it to a certain extent.

Many waters contain small quantities of magnesium salts, such as bicarbonate and sulphate of magnesia (Epsom salts) which owe their presence to the same causes stated regarding the lime salts.

The amount of lime present in water is expressed by

"Hardness,"

water containing much lime being called "hard," and that containing only a little, "soft."

The magnesia salts call for no further comment on account of their analogy in behaviour to the lime salts and of their rarer appearance. The two forms of lime salts in water differ very greatly in their behaviour. For instance, if water containing bicarbonate of lime is exposed for some length of time to the air or heated to a higher temperature (boiling), a white precipitate of carbonate of lime forms whilst the carbonic acid gradually escapes, a phenomenon well known to every owner of a steam boiler as the formation of boiler crust. On long enough boiling or standing the water becomes free from lime as it is deprived of its means of holding carbonate of lime in solution, due to the escape of the carbonic acid. However, water which contains lime in the form of sulphate does not possess this property, as gypsum itself is soluble in water, and cannot be separated by boiling.

Considering these circumstances hardness due to the presence of bicarbonate is called

temporary hardness,

and that due to gypsum is called

permanent hardness.

Hardness is expressed by degrees,

1 German degree of hardness indicating
1 part Ca O (quicklime) in 100,000 parts water.
1 French degree of hardness indicating
1 part $CaCO_3$ (carbonate of lime) in 100,000 parts water.

That is 1 German degree of hardness corresponds to 1·8 French degrees of hardness.

As it is of great importance to the dyer to know the hardness of the water he is employing, a short method is given here of how to ascertain it. It depends on the fact that pure water along with a soap solution forms a lasting froth, whereas hard water does not give such a froth till all the lime has been removed in the form of an insoluble lime soap.

One can then calculate the quantity of lime present in the water, from the quantity of soap solution of a known strength that was required. This result gives the total quantity of lime present in the water; to determine the amount of gypsum present, i. e. the permanent hardness, the bicarbonate is got rid of by boiling and the hardness again determined.

The difference between the two results gives the temporary hardness.

Many waters contain besides lime and magnesia salts also

iron salts;

generally only in small quantities but still frequently to such a degree as to have an injurious effect on the dyeing operations. They are found dissolved in water as the bicarbonate which is thrown out of solution (in the same way as bicarbonate of lime) by standing in the air or by boiling, but at the same time the iron loses the whole of its carbonic acid, and is oxidized by the oxygen of the air to ferric oxide (rust), which separates as an insoluble body in the form of red brown flakes.

The extent of the injurious action exercised by the lime, magnesia or iron salts contained in water of course depends upon the amount present.

The amount of lime, etc. contained in water has a very material effect in the processes of washing and milling with soap to which the textile fibre is subjected. Lime, as stated above, forms an insoluble compound with soap; the so-called lime soap, which has a glutinous nature, and owing to its insolubility no longer possesses the cleansing power of soda and potash soap and therefore is of no use in the washing process. The effect produced by the formation of lime soaps is generally much undervalued, but is by no means unimportant, and especially when using rather hard water. In using water of 10° hardness (German degrees), i. e. water which contains 10 parts of lime (Ca O) in 100,000 parts water, $2^1/_2$ lbs. soap are converted into lime soap for every 100 gall. of water used, and thus have no effect in the washing process.

The influence of lime salts in the various operations to which the textile fibre is subjected, will be referred to in the directions given for applying the Alizarine Colours, and at the same time, details will be given as to how this influence can be counterbalanced.

Purification of water.

Very few dyers have at their disposal water which is free or almost free from lime, and therefore some information about the purification of water may be of interest.

In many cases it will be sufficient to expose the water to the open air in large clearing reservoirs which can suitably made of cemented masonry. By this means the iron and carbonate of lime are precipitated, and the operation can be accelerated by adding some milk of lime, (the amount required being determined by analysis) which deprives the bicarbonate of half its carbonic acid, forming insoluble carbonate of lime.

This process has, however, no effect on the gypsum, and to remove this the addition of soda is necessary, the quantity required being likewise first ascertained by analysis. At the same time the soda removes any excess of milk of lime present by converting it into insoluble carbonate of lime. Water which has thus been completely freed from lime will shew a weak alkaline reaction resulting from the additions of soda and milk of lime, and this fact must be borne in mind in using the water.

The same process is carried out when using the various apparatuses for the purification of water, of which those of

Maschinenbauanstalt *Humboldt* at *Kalk* near *Cologne,*
(system Gaillet),

and of

Mr. *Hans Reisert* of *Cologne,*

may be recommended.

Dyers often purify their water in a simple way by boiling it along with a small quantity of bran and skimming off the lime which comes to the surface with the bran.

Mechanical impurities such as sand, mud, vegetable matter, etc. will rarely be found in such quantities as to have an injurious effect on the dyeing, or the water would have to be cleared in a large clearing reservoir or by means of filtration.

Vats, boilers, apparatuses, and machines.

THE vats, boilers, apparatuses, and machines required in the various mordanting and dyeing operations with the Alizarine Colours are best made of wood or copper, or in a few rare cases of iron.

A more detailed description will be given with the directions for applying the Alizarine Colours.

Treatment of Alizarine Colours in their Application and in Storing.

THE Alizarine Colours are offered to the dyers either in the form of pastes or as powders.

Some of the pastes such as Alizarine Blue S paste, Coeruleïne S paste, are soluble in water, while others are only slightly soluble, but in all of them the colour is in an extremely finely divided state. Owing to this condition, the colouring matter remains uniformly suspended in water for a long time and the gradual settling down only takes place after a long and undisturbed storing, to an extent which depends on the chemical and physical nature of the dye, so that the paste no longer contains equal quantities of dye in all its parts. This, however, is easily rectified by stirring the paste with a wooden stirrer, a precaution which must not be neglected as otherwise invariably equal and correct results cannot be expected.

To stir the paste, the head of the barrel is removed by taking off the top and loosening the second hoop, and a large nail or iron hook is driven into the head by which it can be handled. The lid is knocked out of the groove staves by giving it a few light knocks on one side and can then be easily lifted off. The hoops are again tightened, the opening of the barrel covered with a wet cloth and the lid pressed firmly down upon it.

In no case should the dyestuff be drawn off at the bung, as in this manner the paste does not come into use in its normal strength.

The paste colours often dry up on standing for a long time, especially at a somewhat higher temperature, and therefore they should always be stored in cool rooms, the air of which contains a little moisture. In this manner the paste will be guarded to a certain extent against drying up and this is also materially retarded by covering up the opening of the barrel with a cloth which should always be kept damp.

Frost also throws the Alizarine Colours out of their normal condition, but only temporarily and therefore the colours should always be stored in rooms not exposed to frost.

If, however, by some inadvertence the paste becomes frozen, the barrel is placed in a room which is not too warm, so that its contents may thaw gradually. The colouring matter can then be made perfectly uniform again by stirring, and to make quite sure it can be passed through a sieve into another barrel.

Alizarine Colours in powder are generally soluble in water, and of course are not subject to the danger of drying up or freezing, but on the other hand, if stored in damp air, they are liable to attract moisture, and for this reason should be kept well covered up in dry rooms.

Alizarine Colours either as paste or powder should never be added direct to the dye-bath, but previously dissolved or finely distributed in water as the case may be.

For this purpose the colouring matter is stirred with 10 times its quantity of water, passed into the dye-bath through a fine sieve, and any undissolved part dissolved in a fresh quantity of water.

A very fine distribution of the colour in the dye-bath can be attained by stirring the colour as indicated with water and pouring it into a bag made of fine calico. This is then worked backwards and forward in the dye-bath when dissolved, or finely distributed colouring matter passes through the cloth into the bath liquor.

The following brands must always be dissolved in cold water:—

Alizarine Blue S paste
» » SW paste
» » S powder
» » SW powder
» » SR paste
» » SRW paste
» » SRW powder
Alizarine Dark Blue SW paste
» » » SW powder
Alizarine Indigo Blue S paste
» » » SW paste
» » » SMW paste
Alizarine Green S paste
» » SW paste
Coeruleïne S paste
» SW paste
» S powder
» SW powder
Alizarine Black S paste
» » SR paste
» » SRA paste
» » SW paste
» SW powder
» » SRW paste
» » SRW powder

but all the other brands can be dissolved in hot water.

Conditions of Fastness.

THE important part which the Alizarine Colours play in the textile industry, is due to their great fastness to the various influences to which dyed goods are subjected during the course of manufacture and also later on in wearing. Of course, in testing the fastness of a dye, expectations must not be raised to any unreasonable degree, but must be kept within limits which correspond to the demands and requirements of practical use.

The following are the most important conditions of fastness: —

1. Fastness to light.

By this is meant the power possessed by a colour of resisting the action of sun and diffused daylight, and of the different kinds of artificial illumination.

The words "fastness to light" have, of course, only a relative meaning, as no colours exist that are absolutely fast to light. The demands made regarding fastness to light of a dyestuff depend upon the use to be made of the dyed material.

The intensity and duration of the exposure should be made to agree with the properties of the dyestuff, as a very long exposure may give a wrong impression as to the value of the dye. The testing experiments should always be made in comparison with dyeings whose behaviour under the action of light is already known.

2. Fastness to air and atmospheric influences.

This means the durability of the colours under atmospheric influences such as, air (ozone), rain, snow, seawater, etc., and is closely connected with fastness to light and water.

3. Fastness to water

represents the resistance of the colours to treatment with hot water and depends upon the insolubility of the colour lakes.

4. Fastness to wear and rubbing

is related to the more or less intimate union of the colouring matter and fibre and on this depends the resistance of the colour against mechanical influences such as rubbing and scraping.

5. Fastness to alkalies and soap.

Fastness to washing and milling is of great importance in the textile industry, and depends on the resistance of the colour against alkalies (soda, ammonia, etc.), and soap, to the action of which the material is subjected in manufacture and also later on in practical use.

The test regarding fastness to alkalies must not be carried out with more powerful agents than those used in practice, but must conform to the actual requirements.

6. Fastness to acids

is regarded as the resistance of colours against the action of acids, such as sulphuric acid, in the carbonisation of wool, etc. Even at present it is often considered to be a test for the general fastness of the dye, which is, however, a great mistake. For instance, Alizarine Blue and Anthracene Blue are equally fast to light, but the latter is rather inferior regarding fastness to acid. Again the nitric acid test for the presence of indigo does not give any idea of fastness, Alizarine Blue f. i. behaves like indigo, whereas Anthracene Blue, which is quite as fast, gives a reaction more like that of logwood.

7. Fastness to chlorine.

It is necessary to study the oxidizing (bleaching) effects of chlorine which is used for bleaching cotton to produce a good white, in choosing colouring matters which are required for dyeing goods to be used in combination with white.

8. Fastness to stoving.

In many cases the colours are required to withstand the action of gaseous or aqueous sulphurous acid.

9. Fastness to steaming, shrinking, finishing, and ironing.

Textile goods are frequently subjected to a combined treatment of hot water or steam and mechanical influences, and the amount of resistance of the colour lake to this treatment denotes the fastness of the dye in this direction.

10. Fastness to perspiration.

The effect of perspiration on the various dyestuffs shews itself in many ways in the wearing of clothes. The fastness is tested by treatment with dilute acid, or by sewing a cutting of dyed cloth into a coat which is then worn for some time.

A.

Cotton.

A.

Cotton.

THE important branches of cotton-dyeing and printing with Alizarine Colours are closely related in their principles to the old Turkey-red dyeing process. Owing to the discovery of a great number of Alizarine dyestuffs and the introduction of new mordants and methods of working, dyers and colorists have been enabled to produce a large number of beautiful and fast effects.

Cotton is dyed with the Alizarine Colours in the following stages of manufacture: —

loose cotton
cotton yarn
cotton cloth.

The Alizarine Colours are not suitable for dyeing cotton cops, as they do not penetrate this material sufficiently.

Cleansing of cotton.

In order to obtain fast dyeings it is necessary that cotton be adequately prepared and cleaned like all other textile fibres.

In all cases the removal of impurities from the raw cotton fibre such as adhering dirt, dressing, etc. from the various materials, is effected by boiling with water containing some soda ash or crystals, caustic soda, silicate of soda, or Turkey-red oil.

These additions in conjunction with the higher temperature dissolve the foreign substances, which are then completely removed by washing the cotton. This boiling-off has not only a cleansing effect, but also serves to thoroughly moisten the cotton which is in many cases desirable in order to ensure a uniform absorption of the mordants and dyes, which is necessary for producing even shades. The boiling can be done in wooden tubs, or in iron or copper vessels, which may be open or closed; in the latter case the cotton is boiled under pressure.

If iron or copper vessels are used care must be taken to prevent the cotton coming into contact with the metal, and to do this it is wrapped up in cloth, but tin-plated copper vessels may be used as they are.

In many cases this preparatory treatment of the cotton is quite sufficient, for instance, for dyeing Turkey-red, or medium or dark shades on a chrome mordant.

However, for calico-printing, frequently for yarn-printing, and also for dyeing light shades, the cotton must also be bleached.

This bleaching operation is done by means of hypochlorite of lime or hypochlorite of soda, and recently the electric bleaching process has also been adopted.

Detailed descriptions of the various methods adopted for dyeing cotton are given in the following pages and may be divided into two classes viz: —

I. Cotton-dyeing

II. Calico-printing

which, however, frequently merge into each other, or are applied simultaneously.

I. Dyeing of Cotton.

a) Alizarine Colours on alumina mordant.

ONE method of dyeing cotton which has been known and in use for many centuries past is

Turkey-red dyeing

(dyeing of Alizarine Colours on alumina mordant).

The formerly used madder has been totally replaced by artificial Alizarine, as the latter is cheaper and yields purer and more brilliant shades, and at the same time is easier and more reliable in its application. Cotton is dyed Turkey-red with Alizarine both in the spun state as yarn, and also when woven into piece-goods. This process is not adapted for loose cotton as the Turkey-red oil considerably impairs its fitness for spinning, but it can be used for dyeing light shades, pinks, as in this case the amount of Turkey-red oil used is reduced to conform with the smaller quantity of dyestuff.

The various processes which were formerly used for dyeing Turkey-red with madder, have generally remained the same for artificial Alizarine, but through practical experience and scientific chemical researches have gained materially in clearness and completeness.

There are two principal kinds of Turkey-red dyeing viz: —

Old red, which is produced by the so-called white bath or emulsion process, and

New red, which is based upon the application of Turkey-red oil.

Old red.

The cotton is in this process subjected to a great number of tedious operations, and the dyeings thus obtained are distinguished by a high degree of fastness, which is not attained when working with the shorter process.

The first operation of the old red process after boiling off the cotton as usual, is the treatment with an emulsion of rancid olive oil (huile tournante), and an aqueous solution of soda, which is repeated 2 to 3 times, the yarn being dried each time at a temperature of about 140° F. The object of this treatment is to saturate the cotton fibre with oil, and render the latter fit to absorb the alumina mordant and Alizarine. The excess of oil which is in this manner fixed on the fibre, must be removed by the now following so-called "white baths." The cotton is soaked in these baths which consist of weak solutions of soda, and then dried in the open air. This operation is repeated 3 or 4 times, and the cotton is then well soaked in water which sometimes contains a little soda, and afterwards treated with tannin, sumac, galls, or other tanning materials. This "sumaching" or "galling" has the effect of increasing the purity of the shade.

Now follows the mordanting or aluming operation, the cotton being put into a bath of alum or sulphate of alumina, which has been rendered basic by addition of soda.

The cotton after it has been well washed is ready for dyeing with Alizarine. The cotton enters the cold dye-bath which is then slowly raised to boiling, and boiled for 1/2—1 hour. After dyeing the cotton is brightened by boiling in solutions of soap, soda, and tinsalts.

The "Old red process" is chiefly employed for producing bluish shades on yarn.

It is clear from the above description that the "Old red process" is very complicated; that the Turkey-red dyeing process has been much simplified is due to the discovery of Turkey-red oils, which led to the introduction of the "New red process."

New red.

This very much shorter and simpler process depends on the application of the so-called Turkey-red oils, which are generally produced by saponifying castor oil. If soda-lye is used glycerine and the sodium salt of ricinoleïc acid are obtained, whereas if sulphuric acid is used in place of soda-lye, the sulphoricinoleïc acids are obtained. These Turkey-red oils are soluble in water, and fix themselves on the cotton fibre by one single steeping, and require no subsequent stripping baths but are ready for fixing the alumina after drying.

Turkey-red oil is employed in aqueous solution, and the cotton after the preparation with oil is dried.

The alumina mordant used in the new red process is in many cases acetate of alumina, but probably the one most generally used is the basic sulphate of alumina, which is prepared from sulphate of alumina by addition of soda.

If full red shades are required the oiling and mordanting operations are repeated; it is advantageous to work as follows: Mordant with acetate of alumina, oil, and then repeat the alumina mordant, and this mordanting is followed by chalking in a warm bath of whitening. The cotton after having been well rinsed is then ready for dyeing which is carried out in a similar way to that of old red.

After dyeing the goods are generally steamed, the object being to fix the Alizarine better and to obtain brighter shades. "New red" dyeings are brightened in the same manner as the "Old red" dyeings.

This "New red" process is suitable for yarn and piece-goods, and gives a more brilliant Turkey-red, and the various operations take much less time than in the "Old red" process.

The "New red" process is employed for both blue and scarlet (yellow) shades.

In addition to these two processes the following methods may also be mentioned, although they are not much used in practice.

Steiner's process of Turkey-red dyeing.

This is especially adapted for piece-goods, and differs from the "white bath" process in so far as the oiling is done in a bath of clear olive oil heated to 230° F., and one single treatment is sufficient. After this follow a number of soda-baths, the object of which is to saponify the olive oil, etc.; to render it in a fit state for absorbing the alumina mordant. Mordanting, dyeing, and brightening are carried out as described under "Old red."

Shortened Turkey-red process.

This differs from the "New red" process by the oiling previous to mordanting being omitted. The cotton is mordanted as usual with alumina, and then dyed with Alizarine in a bath to which some Turkey-red oil has been added.

The dyeings which are produced by this process are, however, not so fast as those produced by the "New red" process.

Turkey-red on a mordant of aluminate of soda.

This process is especially adapted for dyeing piece-goods, and is based upon the liberation of alumina from a solution of aluminate of soda by means of sal-ammoniac. The goods are padded in a solution of aluminate of soda to which Turkey-red oil has been added, dried, and then treated with a solution of sal-ammoniac, which causes the alumina to be separated and fixed on the fibre. Dyeing and brightening are done in the same manner as in the "New red" process.

Pink.

The various shades of pink are produced like red, but since smaller quantities of dyestuff are used, the oil and mordanting baths must also be weaker. For this reason, as already indicated, loose cotton can be dyed pink according to the Turkey-red process without becoming unfit for spinning.

Theory and mechanism of Turkey-red dyeing.

The Turkey-red process which was discovered and improved by empirical experiments, has already been the object of numerous chemical investigations, but so far no theory and explanation resting on a scientific ground has been propounded.

Analysis of Turkey-red dyeings shew that the principal constituents of the red are

Alizarine
Lime
Alumina
Turkey-red oil or fatty acids.

It is absolutely necessary that these four constituents be present in every Turkey-red, but they vary considerably in proportion according to the dyeing process employed.

The tin compounds which are frequently used for brightening the dyeings are not absolutely required.

The researches of various scientists have proved that the Alizarine in Turkey-red exists as an Alizarine-lime-alumina (or tin) lake; but the part played by the Turkey-red oil and fatty acids has not yet been definitely explained.

From a mechanical point of view Turkey-red dyeing must be understood as follows: —

The cotton is saturated with fatty acids in the oiling operation, and in the subsequent mordanting process these combine with alumina to form insoluble fatty alumina salts.

The chalking facilitates this combination by neutralizing the acids still present; and at the same time fixes a little lime on the fibre.

During the ensuing dyeing operation the Alizarine forms a lake with the fatty alumina salt, and at the same time the calcareous dye-bath supplies lime as a fourth indispensable ingredient.

The brightening operation removes any impurities that may be present on the fibre, and all imperfectly fixed dyestuff and colour lake, thus clearing and improving the appearance of the shade.

To obtain fast and beautiful Turkey-red dyeings it is mainly necessary to observe the following precautions.

1) The cotton (yarn or cloth) must be freed as much as possible from dirt, dressing, and impurities of the raw cotton, etc., by boiling with soda, etc. If very brilliant and pure shades, especially light reds or pinks, are required the cotton must also be bleached.

2) The quality of the Turkey-red oil used for oiling has, of course, a very great influence. It is advised to use Turkey-red oil F, i. e. sulpholeate which contains about 50% fatty acids and is made from castor oil and sulphuric acid. It dissolves in water with a slight turbidity, and must not be too alkaline or it does not fix well on the cotton fibre.

In place of Turkey-red oil F (sulpholeate), *Turkey-red oil D* may be used, which is made by saponifying castor oil with soda-lye, but is however more used for printing than for dyeing.

In all cases it is necessary to work the cotton well in the oil-bath, in order that the oil can permeate the fibres thoroughly and evenly. A uniform oiling is necessary for uniform mordanting, and consequently for the production of even-dyeings, whereas, if this operation is badly done, streaky dyeings are apt to result.

For this reason it is therefore necessary to bestow great care on the wringing or squeezing of the goods previous to drying, in order to get the oil evenly distributed in the cotton.

The drying of oiled cotton is also of great importance, as if carried out at too low a temperature, or in too short a time, the oil and consequently also the alumina will not be sufficiently fixed, and the finished colour will rub off considerably.

The drying may be done in heated rooms, or in drying machines built especially for this purpose.

The cotton retains only Turkey-red oil from the fluid which it absorbs from the oil-bath, and this bath can be used over and over again.

The oiling of yarn is done either in wooden tubs, or so-called tramping machines, and for cloth suitable vats with squeezing rollers are used.

3) For mordanting the oiled cotton acetate and sulphate of alumina are chiefly used, and only rarely alum.

The acetate of alumina used for Turkey-red dyeing is more correctly speaking sulphate-acetate of alumina, in which the quantities of acetic and sulphuric acids combined with the alumina vary according to the proportion of sugar of lead and sulphate of alumina employed in its preparation. (Pure acetate of alumina free from sulphuric acid is to unstable and therefore cannot be used.) Sulphate of alumina and alum are applied as more or less basic salts, produced by adding soda to the normal salts.

It is necessary in preparing the mordants to consider the hardness of the water, the quality of the Turkey-red oil, the condition of the material to be dyed, and also the required shade. For a correct selection of the mordant it is therefore necessary to examine the Turkey-red oil and the water.

Above all things the alumina mordants must be free from iron, as this metal when in the form of soluble salts forms a violet alizarine iron lake, and therefore dulls the red very much. Insoluble compounds of iron do not, however, do so much damage but should nevertheless be avoided, especially when finely divided, as they dissolve in the acid mordants to a certain extent. The alumina is partly fixed on the fibre by the oil, and partly in consequence of the escape of acetic acid from the acetate of alumina, and the dissociation of sulphate of alumina during drying, and the complete fixation is effected by the chalking. It is also necessary in mordanting to pay the greatest attention to the drying, which is done in similar appliances as stated under oiling.

The alumina mordanting bath can, like the oil-bath, be used again for further operations after adding the requisite quantity of fresh mordant.

4) The object of chalking the mordanted cotton is to complete the fixation of the alumina, by combining the still present sulphuric and acetic acid with lime.

In many cases phosphate of soda, silicate of soda, or other salts of alkaline reaction are used for this purpose, and after chalking the goods must in all cases be thoroughly washed.

The use of wooden tubs is recommended for this operation.

5) The water or rather the lime-contents of the water, plays a very important part in the dyeing operation, and it is therefore necessary to determine the amount present by analysis (determination of hardness). Lime is as already stated a necessary constituent of Turkey-red, and part of the requisite quantity is obtained by the cotton in the chalking bath, and part from the calcareous water used in dyeing. In general water of 5° to 8° of hardness is very well suited for Turkey-red dyeing, and if softer water is employed the necessary quantity of lime is added in the form of whitening, milk of lime, or acetate of lime. If, however, the water is too hard the red is apt to become too bluish and dull, and this is remedied by using a more acid mordant or a weaker chalking bath; the addition of a little acetic acid to the dye-bath is also useful in this case.

To obtain a reliable method for working on a large scale it is therefore necessary that the four factors, the oiling, the alumina mordant, the chalking, and the condition of the water be brought into harmony by means of analytical tests and small dyeing experiments.

For the same reason as in mordanting the water must be free from soluble iron, as a beautiful red can never be obtained with water which contains iron. In this instance insoluble iron compounds can do no harm as the dye-bath is alkaline.

6) Cotton is either dyed in a boiling bath (when a complete combination of the Alizarine with the alumina mordant takes place), or at a temperature of 140°—150° F., but in this latter case the dyestuffs must be afterwards fixed and developed by a separate steaming operation.

The dyeings obtained by this steaming method are much more brilliant and beautiful than those done in a boiling bath.

This steaming is carried out either in an open continuous wooden or iron steam box without pressure, or in suitably constructed iron steaming apparatuses at a pressure of $^1/_2$ to 1 atmosphere. Of course the duration and manner of steaming entirely depends upon the shade of red that is desired.

Cotton yarn or cloth can be dyed in wooden, iron or copper vats, and for yarn-dyeing it is advisable to heat by indirect steam, by means of closed steam pipes fixed at the bottom of the vat under a perforated bottom which serves to prevent too quick or uneven heating of the bath. The vat should be so high that the yarn does not touch this second bottom. Cloth is best dyed in transverse or skein dyeing machines which are supplied in the most varied forms.

7) The object of brightening is to remove the small amount of incompletely fixed dyestuff (combined with oil and alumina), which still adheres to the fibre, and so materially increase the brilliancy and purity of the red. For this purpose soap with or without the addition of soda is mostly used, and sometimes tin salt or some other tin compound are added causing the formation of a tin lake, or rather the tin enters into the ready-formed Alizarine lake rendering the shade yellowish and therefore brighter. Olive oil is also frequently used in brightening, being gradually saponified by the simultaneous use of soda.

In brightening it must not be forgotten that the bluer shades of Alizarine *(V brands)* are faster to soap and alkalies than the yellow shades *(G brands)*, and therefore the latter must not be treated so long or severely as the former.

The brightening process can be carried out either in open wooden tubs or iron vessels, or under pressure in closed kiers similar to those used for boiling-off.

The finished Turkey-red must be dried at a low temperature, as too hot drying renders the shades somewhat brownish and dull, but they recover their tone on being stored for some time, and soon completely regain the brilliancy peculiar to Turkey-red.

For dyeing on alumina mordant the Alizarine Reds in paste are principally employed, but the following Alizarine Colours may also be dyed in that way: —

Purpurine
Alizarine Orange
Alizarine Maroon
Anthracene Blue
Coeruleïne
Anthracene Brown
Alizarine Yellow A and C.

Technical application of Turkey-red.

Cotton yarn dyed with Alizarine (Turkey-red) is used extensively for weaving coloured stuffs, for the production of all kinds of cloth of unsurpassed fastness to light and washing, (dresses, linen, beddings, table covers, etc.). It is also used for knitting and embroidering cotton of all kinds, and for sewing cotton and thread; in fact for all cases where the greatest possible fastness to light and washing is required. The population of Russia, India, etc. purchase immense quantities of Alizarine-dyed cloth for wearing purposes.

b) Alizarine Colours on iron mordant.

(Alizarine Violet.)

The production of a fast violet to black lake by dyeing iron-mordanted cotton with madder, has, like the dyeing of Turkey-red, been known for a long time past.

Artificial Alizarine has in this branch of dyeing also completely replaced madder, for the same reasons as explained with Turkey-red.

Both cotton yarn and cloth are dyed this violet with Alizarine, and to this end the goods are prepared with Turkey-red oil; this operation is, however, not absolutely necessary, but renders the violet purer and more beautiful. The cotton is now impregnated with a solution of a ferrous salt, the one most usually employed being pyrolignite of iron, then dried, and left hanging for some time in the air or in oxidizing rooms, which allows the acetic acid to escape, and the remaining protoxide of iron to pass into the higher state of oxidation (oxide of iron). As in the case of Turkey-red complete fixation is ensured by chalking, and the goods are then ready for dyeing. This is also done in a way similar to that of Turkey-red but in this case the calcareousness of the water is only of minor importance. The shade is improved in purity and brilliancy by a final treatment with soap (brightening). The tubs and apparatuses used for the various operations are the same as those used for Turkey-red.

Of all the Alizarine dyestuffs the one almost exclusively used for this process is

Alizarine Red paste.

The blue shades *(V brands)* yielding the finest, bluest, and fastest violet, and the yellow shades *(G brands)* furnishing more brownish and less beautiful shades which are also not so fast.

Purpurine
Alizarine Orange
Anthracene Brown

can also be fixed on an iron mordant but probably only meet with a limited use.

Technical application of Alizarine Violets.

Dyeings done with Alizarine on iron mordant are used as fast violets in weaving coloured cotton goods on account of their great fastness to light and washing.

c) Alizarine Colours on chrome mordant.

The employment of chrome salts for fixing Alizarine Colours is of a more recent date, and was first tried and introduced principally in calico-printing.

Experiments in the dyeing department led to the discovery of rational methods of fixing chrome on the cotton fibre, thus enabling it to fix the Alizarine dyestuffs and to give fast colours with them.

Chrome mordant is used for cotton yarn and cloth, but this method of dyeing has so far not been used much for loose cotton.

The preparatory operations of boiling and bleaching are done in the same manner as for Turkey-red.

The operation of mordanting cotton with chrome depends on the characteristic of some chrome oxide compounds under the action of water, weak alkalies, and a raised temperature, to pass over into basic salts which are only slightly soluble in water, and finally into oxide of chrome or its hydrate which fixes itself on the cotton fibre giving it a greyish green colour.

This liberation of chrome oxide is mostly supported by an oil preparation similar to that of Turkey-red.

The following processes are in use for this purpose: —

Mordanting with chloride of chrome.

For this purpose the cotton is soaked in a solution of chloride of chrome 32° Tw. and the oxide of chrome precipitated on the fibre by working the latter in plenty of — if possible running — calcareous (hard) water. In this operation it is not only the water itself that acts upon the chloride of chrome in the above stated manner, but more especially the lime in the water. If the water at the disposal of the dyer be too soft, the precipitation of oxide of chrome on the fibre can be assisted by the addition of some whitening, milk of lime, soda, bicarbonate, silicate of soda, or other body with alkaline reaction to the water.

This process is always connected with an oil preparation (as with Turkey-red) when medium or dark shades are required. This causes still more oxide of chrome to be precipitated on the fibre, and on that account the dyeings turn out much more brilliant, fuller, and faster.

In the case of very dark shades which require much dyestuff and therefore also much chrome mordant, the cotton must in addition to the above treatment be worked in a tannin bath, which is prepared from tannic acid, sumac, galls, etc. These tanning materials help to fix the chrome on the fibre by forming the difficultly soluble tannate of chrome.

The chloride of chrome process is the one mostly used for dyeing cotton with Alizarine Colours, as it is suitable for dyeing light, medium, and dark shades of all Alizarine Colours which can be fixed on a chrome mordant.

Mordanting with acetate of chrome.

Cotton can also be mordanted with acetate of chrome, which, strange to say, is more stable than the chloride of chrome, and requires a raised temperature to separate the oxide of chrome.

The operation can be performed in two ways, viz: —

By boiling the cotton

in a diluted solution of acetate of chrome, when the oxide of chrome is gradually separated and fixed on the fibre through the liberation of acetic acid.

By saturating the cotton

with acetate of chrome and fixing the oxide of chrome on the fibre by means of a steaming operation, which causes the acetic acid to volatilize.

It is also advisable to connect these two processes with an oil preparation which helps to fix the oxide of chrome and at the same time increases the beauty and fastness of the shades.

The boiling process is especially adapted for light shades, as only comparatively small quantities of mordant are precipitated on the fibre on account of the stability of the acetate of chrome.

The steaming process can also be employed for medium and dark shades.

Mordanting with alkaline chrome mordant.

(Chromite of soda).

Hydrated oxide of chrome dissolves in concentrated soda-lye forming

chromite of soda,

in the same way as alumina gives aluminate of soda, but whereas aluminate of soda will keep in a diluted solution, the chromite of soda decomposes in presence of much water liberating hydrated oxide of chrome.

The application of chromite of soda for mordanting cotton depends upon this property, the cotton being saturated with a concentrated solution of sodium chromite and then washed in water, causing the separation of oxide of chrome, which remains fixed on the fibre.

The solution of chromite of soda is prepared by adding soda-lye to acetate of chrome; at first a precipitate of oxide of chrome is formed which, however, re-dissolves in the soda-lye. To this mordant one must add some glycerine to prevent the oxide of chrome being thrown out of solution on standing, thereby rendering the mordant useless.

Since this sodium chromite is very alkaline it is recommended to protect the hands by means of India rubber gloves, or to turn and wring the yarn by means of sticks.

This alkaline chrome mordant is suitable for all Alizarine Colours that can be fixed on a chrome mordant.

Mordanting with bisulphite of chrome.

Oxide of chrome combines with sulphurous acid to form bisulphite of chrome, a salt which dissolves in water with a green colour, and which at a raised temperature is transformed by loss of sulphurous acid into basic salts which dissolve with difficulty only; at the same time a partial oxidation into basic oxide of chrome is effected.

The cotton is mordanted by soaking it in bisulphite of chrome and then drying, when the above mentioned process takes place, and the chrome oxide is still better fixed on the fibre in a following soap-bath. For dark shades the mordanting liquor is thickened by an addition of starch, which causes more chrome to be fixed on the fibre.

This process is applicable to all Alizarine Colours which can be fixed on a chrome mordant.

Dyeing.

Cotton mordanted by one or other of the above described methods can be dyed with Alizarine like Turkey-red. Alizarine Red requires the presence of lime in the dye-bath also in these cases, and so do Alizarine Orange and Alizarine Maroon, whereas lime has a rather unfavourable effect on the other Alizarine Colours.

From this it will be seen that water, or rather its lime contents, is also of importance in this case.

Only very hard water contains enough lime for Alizarine Red, Alizarine Orange, and Alizarine Maroon, and therefore as a rule one must add solid acetate of lime to the dye-bath, varying in quantity from $^1/_4$ to $^1/_5$ the weight of the dyestuff used. For the remaining Alizarine Colours the calcareous water has an injurious effect, and is therefore corrected by an adequate addition of acetic acid, a small excess of which is useful as it improves the fixation of the dyestuffs. The amount of acetic acid used is calculated on the temporary hardness of the water, i. e. its bicarbonate of lime contents, as the sulphate of lime (gypsum) has no effect on the development of the colours, provided the dye-bath shews the slightly acid reaction necessary for the Alizarine Colours.

In many cases a little acetate of ammonia (B. A. S. F.) is added to the dye-bath, which has the effect of producing slower and more even dyeing, and after ½ hour boiling the acetic acid diluted with water is added.

The colouring matter is fixed on the fibre by dyeing in a boiling bath, and the dyed cotton is afterwards boiled in a solution of soap, in order to increase the beauty, purity, and fastness of the shade.

This briefly described process can be employed for all Alizarine Colours, except *Alizarine Yellow A* and *C*, which do not yield a useful chrome lake, and *Alizarine Black S* and *S R paste* which are only suitable for calico-printing.

Technical application of Alizarine Colours on chrome mordant.

Cotton yarn dyed with Alizarine Colours on a chrome mordant is used in weaving coloured cotton goods which are fast to light and washing. Alizarine Blue dyeings advantageously replace those done with indigo, since they are very fast to washing and chlorine. Alizarine Colours on a chrome mordant are also very serviceable (in calico-printing) for dyeing all kinds of cloths.

d) Alizarine dyed on combined mordants of alumina, iron, and chrome.

A great number of shades can be obtained with the Alizarine Colours which can not be got with the single mordants, by using a suitable combination of alumina, iron, and chrome mordants. Such combinations are much used in practice; Alizarine Red, for instance, being dyed on a mordant of alumina and iron, or alumina and chrome to produce claret shades.

Of course the number of these combinations is very great; the mordants used and their proportion to each other must be selected according to the desired shade, and the shades can also be varied at pleasure by using stronger or weaker mordants.

The mordanting operations are carried out in a similar way as described in the different processes. The cotton may be treated with the respective mordants successively, or they may all be mixed together in one bath, but probably the first will deserve the preference.

In the following a few short notes are given referring to suitable combinations of mordants, and the operations are carried out according to the operations for the separate mordants.

Combined mordant of alumina and iron.

1. *Boiling-off*
2. *Acetate of alumina 9° Tw.*
3. *Oiling*
4. *Acetate of iron 1½—12° Tw.*
   (according to shade desired)
5. *Chalking*
6. *Dyeing*
7. *Brightening.*

By this process Alizarine Red furnishes various claret shades, Anthracene Brown full dark brown shades, etc.

Combined mordant of chrome and alumina.

1. *Boiling-off*
2. *Chloride of chrome 32° Tw.*
3. *Oiling*
4. *Acetate of alumina 3° to 9° Tw.*
   (according to shade desired)
5. *Chalking*
6. *Dyeing*
7. *Soaping.*

In this way Alizarine Red yields brilliant clarets.

e) Alizarine Colours on cotton dyed in one bath.

In all the processes so far described the cotton must first be mordanted and then dyed in a separate operation.

This separation is necessary as, if Alizarine Colours and mordants are used in the same bath, they form lakes on meeting in the liquor instead of on the fibre; these lakes are no longer capable of being fixed on the fibre, and consequently this causes a loss of dyestuff as well as other unpleasantness such as rubbing-off, etc.

However, in a few cases the two operations of mordanting and dyeing can be united in the so-called

One-Bath process.

This process is suited for light shades which require only little dyestuff on alumina and chrome mordant. Alum and acetate of chrome are used for the mordanting, and the fixation is effected by boiling.

The dyeing operation must be explained in this manner; during the boiling the cotton absorbs the alumina or chrome, which then combines with the Alizarine dyestuff forming the colour lake on the fibre. However, since the formation of the colour lake in the liquor can never be totally avoided, the one-dip process is only suitable for the production of very light shades.

The small quantity of dye required for that purpose is comparatively speaking quickly attracted by the fibre, and for this reason not much colour lake can be formed in the bath.

Since in this case light brilliant shades are produced the cotton must be bleached after being boiled off.

All Alizarine Colours can be dyed on cotton yarn or cloth by this method.

f) Padding Process.

This process is similar to the one-dip method and consists of saturating the cotton with a solution containing colouring matter and mordant, and after being well dried the colour lake is developed by steaming.

The depth of the shade can be regulated by using larger or smaller quantities of colour and mordant.

For dark shades it is advisable to add some starch solution to the padding liquor, as this has the effect of bringing more dyestuff and mordant on to the fibre.

This process is especially suited for the soluble bisulphite compounds of Alizarine Blue, Alizarine Green, Alizarine Indigo Blue, Coeruleïne, and Alizarine Black which do not unite with chrome salts in the cold but do so at a higher temperature in the steaming process in this instance to form chrome lakes.

II. Calico-Printing.

In the dyeing processes so far described cotton yarn and cloth is dyed one plain colour only.

In a large department of the cotton industry, however, in calico-printing, the task is placed before dyers and colourists to apply the colour to certain parts of the goods only, or to supply the latter with several colours at a time or in succession.

These conditions can be brought about by a number of methods, which proceed as in dyeing by fixing the mordant on the fibre and then uniting the colouring matter with the mordant.

But whereas in dyeing proper, Turkey-red, etc., the cotton is first mordanted and then dyed in a separate operation, the calico-printer has other methods at his disposal, which in their main features can be divided into four groups viz: —

1) Fixing the mordant and dyeing in two separate operations,
    a) Printing-on the mordant
    b) Discharging the mordant.
2) Simultaneous fixation of the mordant and dyestuff, i. e. dyeing the cotton by making use of the steaming process,
    Steam-printing.
3) Dyeing the cotton and discharging the colour,
    Discharge-printing.
4) Preventing certain parts of the material from being dyed by printing-on preservatives, so-called resists, and then dyeing or printing,
    Resist-printing.

These methods can be applied separately, or several of them may be combined together.

The purification and preparation of cotton cloth for printing requires the most careful attention to a still greater extent than in dyeing, or the colouring matter will be only imperfectly fixed, and the colour will consequently not be a fast one.

The cotton is first purified as described for dyeing purposes by boiling in suitable apparatuses with water containing soda ash, caustic soda, or silicate of soda, etc., but for printing it must also be bleached, which in most cases is done by means of chlorine, and recently an electric method has also been employed.

Most of the Alizarine Colours can be printed at once on the cleaned and bleached material, but as in Turkey-red dyeing, Alizarine Red requires the application of Turkey-red oil to furnish brilliant shades. The cloth is prepared (padded) with a solution of Turkey-red oil, except when dyeing on a printed or discharged mordant, in which case the Turkey-red oil is added to the dye-bath.

In printing it is necessary to thicken the mordant or mixture of mordant and dyestuff which has to be printed on, with suitable thickenings, such as starch, gum, dextrine, etc., so as to give the printing colour a better consistency and thereby give sharp outlines to the patterns, prevent the colour running into the white and to sufficiently fill up the engravings of the rollers. The preparation of thickenings and printing colours forms a very important branch of calico-printing, and great care must be given to their correct treatment.

Thickenings.

Aqueous solutions of mordants and dyes have like water itself a great tendency to spread and run over the surface of the cloth, owing to the capillary attraction of the cotton fibre.

To prevent this, the printing colour is thickened with suitable substances which retain the mordants and dyes exactly on the places they are printed on.

Gum and amylaceous matters from the vegetable kingdom are used as thickening agents for the Alizarine Colours, as in combination with water they assume a slimy, sticky, and consistent form, and so retain the water on the cloth and prevent it running on to unprinted parts.

Besides this indispensable condition the thickening must also answer several other requirements. The printing colour thickened with them must spread in uniform layers over the printed parts, so that the colour is everywhere developed with equal intensity. Further, they must have no influence whatever on either mordant or colour, and must be such as can be thoroughly and easily removed from the material by washing after the prints have been fixed.

The following are the thickenings principally used for the Alizarine Colours:

Starch. Wheat, potato, rice, maize starch, etc., is stirred to a liquid pulp, with cold water and then changed by boiling into a suitable paste. The boiling is best done in double-cased brass or copper pans heated by steam, and the paste is continually stirred, which on the large scale is done by mechanical stirring appliances. In order to obtain the required fine distribution and pliantness, the stirring must be continued till the paste is quite cold. The starch paste is finally passed through a fine hair-sieve or a piece of fine calico, in order to retain any coarse ingredients or impurities it may contain.

Starch thickening is liable to ferment and turn sour when standing in warm rooms, and thereby lose the properties required for printing purposes. Such an alteration is prevented by adding some substance such as acetic acid, salicylic acid, etc., which impedes fermentation.

Starch thickening can be used for all Alizarine Colours, and is especially suitable for medium and full shades.

Wheat flour is applied like starch.

Gum, of various quality and origin, is available in two forms, such as is soluble in water, as gum arabic and gum senegal, and other that is insoluble such as cherry gum, gum Bassorah, etc.; but these can also be rendered soluble by heating with water. Gum arabic, (or the other kinds that have been rendered soluble) is applied in aqueous solution, which is best prepared by pouring an equal weight of water over the lumps and allowing to swell up for a few hours, then dissolving by heating on a water-bath, and finally passing through a fine cotton cloth to remove impurities such as sand, bits of wood, and bark, etc. This gum thickening is particularly suited for light brilliant shades.

Dextrine is treated and applied like gum.

British gum, farina, dark British gum, light British gum are boiled with water and stirred till cold; from their properties and method of employment they may be considered as standing between starch and gum.

Gum tragacanth, even in rather small quantities possesses a considerable thickening power and swells up to a thick jelly if allowed to stand well with water for several days. It is brought into solution by boiling for some time, which is mostly done under pressure. Tragacanth thickening is frequently used as an addition to starch thickening. In selecting a suitable thickening account must be taken of the nature of the colouring matters and mordants, of the shades required, and of the condition of the material to be printed. Below are some recipes for thickenings which are well suited for Alizarine Colours.

Starch thickening.

2 lbs. starch
5 lbs. gum tragacanth solution (60 : 1000)
1¼ lbs. olive oil
2 gall. water

are stirred in the cold and then boiled till a uniform paste is formed, then stir till cold and finally pass through a fine sieve.

Wheat flour thickening.

7 lbs. wheat flour
4 gall. water

are stirred together then boiled to a uniform paste, then stirred till cold and passed through a fine sieve.

Gum thickening.

10 lbs. gum arabic
1 gall. water

are steeped together for 12 hours and then dissolved by heating on a water-bath, and when cold pressed through a piece of fine calico.

Gum tragacanth thickening.

6 lbs. gum tragacanth
10 gall. water

are let stand 2 to 3 days in a warm place until the mixture has become a uniform jelly, then boiled for 2 to 3 hours in an open boiler, or for 1 hour under pressure, and when cold pass through a fine sieve.

British gum thickening.

10 lbs. British gum
½ gall. water

are boiled together for ¼ hour, stir till cold and pass through a fine sieve.

Description of the various printing methods.

1 a. Printing-on of the mordant.

In this method the cotton cloth is first printed with the mordant, which has been prepared with starch thickening.

In this case a previous preparation of the goods with oil is not possible or the white would absorb some colouring matter in the dyeing process and not remain sufficiently clear.

The mordants used are:—

Acetate of alumina
for red and pink with Alizarine Red, for Alizarine Orange and Alizarine Maroon.

Acetate of iron
for violets and black done with Alizarine.

Acetate of chrome
for claret with Alizarine Red and also for the other Alizarine dyestuffs.

These three mordants are often combined together and so yield a variety of shades. To obtain shades of different depth the quantity of mordant used or its strength is varied. The number of shades obtainable can also be increased by simultaneously printing-on mordants of different kinds.

The mordants are fixed in the same manner as in dyeing.

Alumina and iron mordant are developed by hanging up in the open air (oxidation), whereas chrome mordant requires a steaming process. The fixation of alumina and iron mordant is completed by treatment in a chalk-bath, after which the goods are washed.

The dyeing is done in the same manner as the shortened process for Alizarine Red, and the Alizarine Colours on iron and chrome mordant; all the Alizarine Colours that were mentioned in that connection may be used for dyeing on printed-on mordants.

Technical application of printed-on mordants.

The above process is largely used for producing red dyed goods by printing on alumina mordant and then dyeing with Alizarine Red. A fast violet can also be obtained by dyeing on a printed-on iron mordant with Alizarine Red, and Anthracene Brown is frequently fixed on a compound mordant of alumina and iron.

1 b. Discharging the mordant.

Alumina, iron, and chrome mordants can be **discharged** previously to being completely fixed on the fibre, by printing-on acids or acid salts, that is to say, they can be rendered soluble and then be removed by washing after the mordant has been fixed.

In this case also the oil preparation is omitted for the sake of producing a good white, but Turkey-red oil is afterwards added to the dye-bath.

The cloth is either padded or printed with the mordant, and then dried and printed with the discharge paste.

The following mordants are used for the production of these discharge goods: —

Acetate of alumina

for red and pink with Alizarine Red, for Alizarine Orange and Alizarine Maroon.

Acetate of iron

for violet and black with Alizarine Red.

Bisulphite of chrome 48° Tw. B.A.S.F.

for claret with Alizarine Red, and for other Alizarine Colours.

These mordants can be used in different strengths and also combined together in various proportions.

Organic acids such as tartaric acid, citric acid, etc., are mostly used for discharging, and also such acid salts as bisulphate of soda. The mordant is fixed in those places that have not been printed with the discharge by hanging up or by steaming, but in the places where it is discharged it is kept in solution by the action of the acids, and then removed by a good washing; alumina and iron mordants require a chalk-bath before washing.

The dyeing is done in the same way as with the printed-on mordant.

To produce a pure white when using Alizarine Red, the goods are passed through a weak chlorine bath after soaping.

Technical application of discharged mordants.

Discharged alumina and iron mordants are used like the printed-on mordants for producing dyed red and violet goods.

The so-called chrome-dyed goods are obtained with the various Alizarine Colours on discharged chrome mordants.

2. *Steam-printing.*

In the printing methods so far described the mordant is first fixed on the cloth, and then the dyeing is done in a separate operation. In steam-printing the colour lake is formed in one operation as the dyestuff and mordant are printed together in a thickened state on the cloth, which is then dried and placed in a steaming apparatus, where the colour is developed under the influence of steam. For Alizarine Red, Purpurine, Alizarine Orange, and Alizarine Maroon, the cotton must undergo an oil preparation as in Turkey-red dyeing, and is therefore padded in a solution of Turkey-red oil and then dried.

The other Alizarine Colours do not require this treatment, but can, however, be printed on prepared cloth.

Turkey-red oil cannot be added to the printing colour in place of the oiling operation as that would give less favourable results.

The preparation of the printing colour requires great care and attention. The thickening must be selected according to the desired shade; a starch thickening being employed for full dark colours, whereas a gum thickening is more suitable for light colours. The Alizarine Colours are employed partly as insoluble but very fine pastes, and partly in the form of soluble pastes and powders. In the former case they must be very evenly distributed in the printing colour, but in the latter they are dissolved in the thickening.

When using insoluble colours such as Alizarine Red, Anthracene Brown, etc., the thickening is generally prepared first by boiling, and then stirring till cold, and finally adding the dyestuff. In many cases, however, it is possible to boil the dyestuff together with the thickening, and then stir till cold, and by this method a very fine distribution of the dyestuff is attained.

The soluble bisulphite compounds of Alizarine Blue, Alizarine Indigo Blue, Alizarine Green, Coeruleïne, and Alizarine Black must be treated only according to the first method, as at the boiling temperature the bisulphite compounds are decomposed, and the colours converted into an insoluble condition less suitable for printing.

The paste colours are carefully stirred with the thickening, whereas the powders are first dissolved in pure cold water and the solution then added to the thickening. The different mordants are now added to the printing pastes, and the whole then thoroughly and evenly stirred.

Alumina, iron, and chrome salts are used as mordants in calico-printing, and for Alizarine Blue zinc and nickel salts are used. Many dyestuffs require an addition of acetate of lime, and Alizarine Red requires oxalate of tin. These mordants must only be added to the cold printing colour or thickening, as the mordants and colours would form lakes at a raised temperature, and also a portion of the volatile acids would be set free and lost by evaporation, and thus the mordants would be less suitable for printing purposes.

The amount of dyestuff used depends on the required shade, and the quantity of mordant upon the amount of dyestuff to be fixed. As a rule a so-called standard printing colour is prepared, and the colours required for lighter shades are made from it by diluting it down with thickening.

The formation of the lake, i. e. the union of mordant and dyestuff is as already stated effected by a steaming operation. However, this union takes place at the ordinary temperature when the printing colour is left standing for some time, and especially in warm rooms, and some lake is already formed in the printing colour and can no longer be fixed on the fibre, and therefore the shade is rendered lighter. A volatile acid, as a rule acetic acid, is added to the printing colour or thickening respectively, to prevent this premature formation of the lake as much as possible.

This acidity prevents or rather retards the formation of the lake, which takes place only after the acetic acid is expelled in the steaming process.

No acetic acid must be added to the soluble brands of Alizarine Blue, Alizarine Indigo Blue, Alizarine Green, and Coeruleïne as it would decompose the bisulphite compound. In this case, the formation of lake in the printing colour is retarded on account of the bisulphite compounds being stable in the cold, but still not to such a degree as with the other Alizarine Colours, and with *Alizarine Blue S paste*, etc., one should only prepare as much colour as is wanted for the day. *Alizarine Black S paste*, and *S R paste*, are more stable, and an addition of acetic acid can be made to the printing paste.

For the above-stated reasons the ready-made colouring matters must be kept in a cool place till required for use.

Cotton cloth is mostly printed with printing machines (rollers), but frequently also by hand especially in printing very wide fabrics. The most important parts of a printing machine are the printing rollers made of brass or copper on which the pattern is engraved. The engraving holds more or less colour according to its depth, and thereby produces darker or lighter shades on the cloth.

On leaving the printing machine the cloth is passed directly over the drying machine (heated cylinders, etc.), and this drying is of great importance in developing the colour.

The dyestuff is fixed, i. e. the colour lake is formed during the steaming process, which varies according to the nature of the dyestuffs and mordants, the kind of cloth, and the intensity of the shades.

The different forms in which steam is used are on the one hand: —

Open steam, which has a free issue, being under ordinary atmospheric pressure.

Tensioned steam, which is used in closed machines under a pressure of $^1/_2$ to 2 atmospheres; and on the other hand

Dry steam, which contains no condensed water.

Damp steam, which contains water in the form of steam, and also in a finely condensed state.

Dry steam, open or under pressure, is almost exclusively used in printing Alizarine Colours on cotton.

The tension of the steam and the duration of its action depend upon the nature of the mordant and dyestuff used, upon the intensity of the shade desired, and on the quality of the material, etc. The goods are very often first treated with open steam in wooden steam-boxes so as to remove the greater part of the acetic acid, etc., which would have an injurious effect on the iron steaming apparatus.

After steaming in order to remove the thickening, and whatever dyestuff that may not have been fixed, the material is washed well with clean water, and for prints that have been done with starch thickening an addition of malt is frequently made to the water, which renders the starch soluble by the action of the diastase, and so makes it easier to remove from the cloth. Before soaping the cloth it is very important that all thickening, etc. be removed by a thorough-washing with water.

Alizarine Red and Pink require a treatment with a warm chalk-bath before washing, to neutralize the acids.

After washing the prints are soaped in order to increase the beauty and brilliancy of the shades, and for Alizarine Red and Pink on alumina mordant a little soda or tin salt is added to the soap-bath.

The goods are in many cases finally bleached in order to increase the purity of the white.

Technical application of the Alizarine Colours in steam-printing.

The Alizarine Colours are largely used in steam-printing for producing colours that are fast to light and washing on all kinds of textile fabrics such as wearing materials, furniture, curtains, etc.

3. Discharging the colour.

According to this method the cotton cloth is dyed with the Alizarine Colours in one of the above described ways or, if the colour is only required on one side of the material it is printed-on and then suitable discharging agents are printed-on to the places where white is required.

Besides thickenings the discharging pastes contain **acids, alkalies** or sometimes **oxidizing substances.** In the first case in **discharging with acids,** which is generally used for Alizarine Red on alumina or iron mordant, the acid breaks up the colour lake into dyestuff and mordant, and at the same time renders the latter soluble. On passing the goods through a solution of bleaching powder chlorine is developed on the places where the discharge was printed and turns the colour to white by destroying the dyestuff.

On account of the treatment with bleaching powder this method is only applicable for dyestuffs that withstand the action of chlorine, such as Alizarine Red and Alizarine Orange. Both light and dark shades can be discharged by this method.

Alkaline discharges are also employed for discharging Turkey-red, for instance soda-lye (in conjunction with silicate of soda). The cotton dyed with Turkey-red is printed with a thickening containing soda-lye and silicate, and then steamed; by this process the colour lake is decomposed, and the Alizarine dissolves in soda-lye and is removed by washing. Finally, to increase the purity of the white, the goods are treated with dilute sulphuric acid, then washed and soaped.

Those **discharges** containing **oxidizing substances** serve chiefly for discharging Alizarine Colours on a chrome mordant. For this purpose bromates and chlorates are employed (the latter in combination with red prussiate of potash), which by developing bromine or chlorine oxidize and destroy the dyestuff. In this method the discharges are printed-on to the dyed or printed cloth which is then dried and steamed.

4. Resist-printing for mordant and colour.

The resisting or reserving process consists of preventing the mordants and dyestuffs from fixing themselves on certain parts of the material, and this can be done in two different ways: —

By **resisting the mordant,** by printing the cloth previous to mordanting with suitably thickened substances, which prevent the fixation of the mordant in a mechanical or chemical way.

By **resisting** the **colour,** by printing the unmordanted cloth with mechanically or chemically acting substances, and then printing on a mixture of dyestuff and mordant.

The resisting of the mordant in the mechanical way is done as follows:

The cloth is printed on those places that are intended to remain white with a paste consisting chiefly of starch thickening and clay (china clay). The mordant can now be either printed-on, or padded, and in the reserved places the material absorbs no mordant and therefore no colouring matter in the ensuing dyeing process. The reserving paste is removed by washing after the mordanting or dyeing.

The mordant is resisted in a chemical way by printing on acids such as citric acid, tartaric acid, or sulphuric acid along with clay (china clay) and a suitable thickening. The mordant is afterwards padded or printed-on, and in the reserved places is dissolved or converted into an unfixable condition so that in the following dyeing process no colouring matter is absorbed in these places.

In calico-printing the colour is resisted in a mechanical way by printing-on a reserve paste which prevents the printing colour coming into contact with the cotton fibre, or in a chemical way by printing-on a resist paste which prevents the formation of the colour lake on the reserved places.

5. "Ombré" Prints on cotton yarn.

This is used for producing special effects in weaving coloured stuffs and is frequently carried out with the Alizarine Colours. A particular form of yarn-printing machine is used for this purpose, and patterns of one or more colours are produced by it; the process used is quite similar to that of steam-printing with the Alizarine Colours. The cotton yarn is boiled off with soda, and as a rule also bleached.

In using Alizarine Red, Alizarine Orange, and Alizarine Maroon, the yarn must be oiled, but this operation is not necessary for the other Alizarine Colours. Starch is mostly used as thickening, and the printing colours are prepared as in calico-printing, with the exception that acetate of alumina is used for Alizarine Red on alumina mordant instead of sulphocyanide of alumina, as the latter is apt to injure the yarn in the steaming process. The colours are fixed as in calico-printing by drying (at a temperature not above 120° F., as otherwise the white easily turns yellowish) and steaming; finally the yarn is washed and soaped.

All the Alizarine Colours are adapted for yarn-printing.

Fastness of the Alizarine Colours on Cotton.

THE Alizarine Colours are distinguished by their great fastness against the most varied influences. Of course all colours in this class are not equally fast as they differ in chemical constitution. On the other hand, the methods of fixation and the selection of the mordants play a great part with regard to the fastness of the shades, and finally it is of the greatest importance for the quality of the dyeings obtained that these methods are carried out correctly.

In testing the fastness of the dyes, it is above all necessary to bear in mind that the depth of the shade is a very essential point. It is a well-known fact that the destructive action of light, the influence of acids and alkalies, etc., affect the light shades to a much greater extent than the dark shades. It is therefore necessary that comparative tests of dyestuffs must always be made with dyeings of equal depth of shades, or else quite incorrect ideas of the fastness will be arrived at.

Below are given some details regarding the fastness of the Alizarine Colours on cotton.

1. Fastness to light.

In testing the fastness to light of a dyestuff it is best to use dyed pieces of cloth, which should be suspended in a sunny place either in the open air or covered by glass, and a pattern for comparison is retained protected from light. The duration of the exposure must conform to the nature of the dyestuff, to the way it has been fixed, to the use the material is intended for, and the requirements connected therewith, also to the state of the weather.

The Alizarine Colours can be divided into the following 4 groups according to their fastness to light: —

First group, — *Turkey-red.*

Turkey-red is well known to be the fastest colour that can be obtained with organic dyestuffs on cotton, and may pretty well be called indestructable.

Second group, — *Alizarine Red, dyed, and steam-developed on alumina mordant.*

These colours are not so fast to light as Turkey-red, and to this group belong dyeings and prints done with Purpurine and Alizarine Orange on alumina mordant.

Third group.

Alizarine Red on iron and chrome mordant

is typical of this group, and the following rank with it: —

Alizarine Orange on chrome mordant
Alizarine Blue » » »
Alizarine Indigo Blue on chrome mordant
Alizarine Green » » »
Anthracene Blue » » »
Anthracene Brown » » »
Coeruleïne on chrome and alumina mordant
Alizarine Black on chrome mordant
Alizarine Yellow A.

Fourth group

comprises the following dyestuffs: —

Alizarine Maroon on alumina and chrome mordant
Alizarine Blue on zinc and nickel mordant
Anthracene Blue on alumina mordant
Galleïne on chrome mordant
Galloflavine on chrome mordant
Alizarine Yellow C on alumina mordant
Mordant Yellow on chrome mordant.

The fastness to light of the members of each of these four groups decreases a little from the first to the fourth group.

2. Fastness to water.

Alizarine dyeings and prints on cotton are without exception very fast to water. The test is made by immersing a cutting of a dyeing in hot water for 12 hours which is allowed to cool down gradually.

3. Fastness to air and weather.

The fastness of colours against atmospheric influences is composed of the fastness to the action of sun and diffused daylight, and the fastness to water in the form of rain, snow, thaw, hoar-frost, etc.

This test is made by exposing the dyeings to the open air.

4. Fastness to wear and rubbing.

Most Turkey-red dyeings done with Alizarine on alumina mordant rub off a little, which is due to the oil preparation, but this rubbing-off can be avoided by a good washing and soaping.

The rubbing-off of printed Alizarine Colours is mostly due to the thickening not having been thoroughly washed out before soaping.

The test for rubbing is done by rubbing the dyeings with a piece of white cloth or paper.

5. Fastness to washing, to soap, and alkalies.

The fastness of the Alizarine Colours to washing, soap, and alkalies depends upon the power possessed by the colour lakes of resisting the action of alkalies, such as soap, soda, lime, etc.

The degree of fastness against alkalies depends upon:

1) the kind of alkali, soda, soap, etc.
2) the concentration of the washing liquor.
3) the temperature of the washing liquor.
4) the time of its action.
5) the mechanical treatment in the soaping operation, etc.

These different items should conform to the nature of the dyestuffs, to the way they have been fixed and the use to which the cotton is to be applied.

1. The kind of alkali.

The textile fabrics have during the course of manufacture and also in their practical use, to undergo various washing operations which are partly done with soap alone, and partly with a mixture of soap and soda. The effect of the combined soap and soda-bath is of course much more energetic than that of soap alone.

2. The concentration of the washing liquor.

The Alizarine Colour Lakes are more or less affected and dissolved by strong alkalies (soda), whereas soap-baths even of a higher concentration only exert a minor influence. The action of weak soda and soap-baths is resisted remarkably well by the majority of Alizarine Colours.

3. Temperature of the washing liquor.

The effect of soda and soap-baths on the Alizarine Colours increases with increase of temperature. Many of them withstand the action of a boiling soap-bath very well, whereas others require a lower temperature.

4. The time of action of the washing liquor.

A shorter or longer duration of the action of the washing liquors on the various Alizarine Colours, leads to a smaller or greater quantity of lake being dissolved and to a more or less noticeable alteration of the shade.

5. The mechanical treatment in washing.

The chemical effect of soap and soda in the washing operations is increased by mechanical friction which is intended to promote the removal of dirt, etc. The more intimately the colouring matter is united with the fibre, the better will be its resistance against mechanical influences.

Alkalies and soap can affect the colours in the following ways: —

a) by reducing the intensity of the dyeings by dissolving and removing part of the colour lake.

b) by altering the shade owing to the formation of basic lakes.

c) by tingeing interwoven white cotton, wool, or silk with the removed colouring matter, i. e. running of the colour into the white.

The washing operations used in practice, and in the testing methods in connection with them, by which the fastness of the dyestuff is determined, correspond to the requirements which the dyeings are expected to answer.

The following methods are suitable for testing the fastness to washing of a dyestuff.

1. Weak washing.

Treat at 140° F. for a quarter of an hour with

5 parts of soap in
1000 water.

2. Severe washing.

Treat for a quarter of an hour in a boiling bath of

5 parts soap
2 » soda
1000 » water.

The washing experiments are best done with a skein of dyed cotton intertwined with white cotton, wool, and silk, and from the results of these experiments the Alizarine Colours may be divided into various groups.

a) Regarding loss in intensity of shade.

First group.

With the following the shade does not perceptibly alter in intensity with a weak or severe washing: —

Alizarine V1 and V2a bl. sh. (blue shades)
(chrome and alumina mordant)
Alizarine Orange (chrome mordant)
Alizarine Blue (chrome mordant)
Anthracene Brown (chrome and alumina mordant)
Galleïne (chrome mordant)
Coeruleïne (chrome mordant)
Alizarine Black (chrome mordant).

Second group.

In the following cases the shade does not lose perceptibly with weak washing but does so with severe washing: —

Alizarine GD and SX (scarlet shades)
(alumina and chrome mordant)
Alizarine GI and RG (yellow shade)
(chrome mordant)

Purpurine (alumina mordant)
Alizarine Orange (alumina mordant)
Alizarine Maroon (alumina and chrome mordant)
Alizarine Indigo Blue (chrome mordant)
Alizarine Green (chrome mordant)
Anthracene Blue (chrome mordant)
Coeruleïne (alumina mordant)
Galloflavine (chrome mordant)
Carbazole Yellow W (chrome mordant).

Third group.

The shade of the following loses perceptibly in a weak as well as in a severe washing: —

Alizarine G I (yellow shade)
  (alumina mordant)
Anthracene Blue (alumina mordant)
Mordant Yellow (chrome mordant).

b) Regarding alteration of shade.

The following Alizarine Colours alter in shade with severe washing, turning more greenish: —

Alizarine Blue (chrome mordant)
Alizarine Indigo Blue (chrome mordant)
Alizarine Green (chrome mordant)
Anthracene Blue (alumina and chrome mordant)
Alizarine Black (chrome mordant).

The other Alizarine Colours do not alter their shade in washing.

c) Regarding running into interwoven cotton, wool, and silk whites.

The following Alizarine Colours tinge interwoven cotton, wool, and silk a little in severe washing: —

Alizarine G D (scarlet shade)
  (chrome mordant)
Alizarine Maroon (alumina mordant)
Carbazole Yellow W (chrome mordant).

(The latter tinges very much.)

The following stain only wool and silk: —

Alizarine V I (blue shade)
  (chrome mordant)
Alizarine Orange (alumina mordant).

The following stains only cotton: —

Alizarine G I (yellow shade)
  (chrome mordant).

All other colours leave interwoven white clean.

6. Fastness to acids.

Alizarine Colours on cotton are not expected to be very fast against acids, as cotton itself, like all vegetable fibres, possesses no great resistance against acids.

When chloring dyed red or steam-red the goods are as a rule passed through a cold dilute bath of sulphuric or hydrochloric acid after leaving the chloring bath, and all Alizarine Colours that are fast to chloring withstand this treatment.

Dyeings on cotton that are fast to acid are frequently wanted for the manufacture of half-woollen and half-silk goods.

The following dyes are very fast to acids: —

Alizarine Red (alumina and chrome mordant)
Alizarine Orange (alumina and chrome mordant)
Alizarine Blue
Alizarine Indigo Blue
Alizarine Green } *(chrome mordant).*
Galloflavine
Alizarine Black

The following are not so fast to acids: —

Alizarine Maroon (alumina and chrome mordant)
Anthracene Blue " " " "
Anthracene Brown " " " "
Galleïne (chrome mordant)
Coeruleïne (alumina and chrome mordant)
Alizarine Yellow (alumina mordant)
Carbazole Yellow W (chrome mordant)
Mordant Yellow (chrome mordant).

7. Fastness to chlorine.

The fastness of the Alizarine Colours to chlorine plays an important part, as dyed and printed goods are frequently treated with a bleaching powder solution to obtain a good white. Cotton is also often treated with bleaching powder in the washing process, and in this case also colours which are fast to chlorine are required.

The following are very fast to chlorine: —

Alizarine Red (alumina and chrome mordant)
Alizarine Orange (alumina and chrome mordant)
Alizarine Blue (chrome mordant).

The remaining Alizarine dyestuffs resist a light treatment with chlorine to a greater or lesser extent, but are noticeably affected by a strong treatment.

8. Fastness to stoving.

It is seldom that the fastness of Alizarine Colours on cotton to stoving comes into consideration, but it is of certain importance for union goods (white wool and dyed cotton) which are often subjected to stoving to obtain a pure white.

Most Alizarine Colours on cotton are very fast to stoving, but the following brands are not so fast:—

Alizarine G I on alumina and chrome mordant
Purpurine on alumina mordant
Alizarine Maroon on alumina mordant
Anthracene Brown on alumina mordant
Galloflavine on chrome mordant
Anthracene Blue on alumina mordant
Carbazole Yellow on chrome mordant
Mordant Yellow on chrome mordant.

9. Fastness to ironing.

The Alizarine Colours stand hot ironing without any perceptible alteration; Alizarine Red becomes a little duller, but the shade recovers completely after some little time.

10. Fastness to perspiration.

The Alizarine Colours are very fast to perspiration and satisfy the greatest requirements.

Directions

for

Dyeing and Printing Alizarine Colours on Cotton.

No. 1. (No. 370, 395.)

Directions for dyeing

Cotton with Alizarine Colours on an alumina mordant.

(Turkey-red dyeing.)

Only the following Alizarine Colours are adapted for dyeing cotton (yarn or cloth) according to this process: —

Alizarine paste
Purpurine
Alizarine Orange
Alizarine Maroon
Coeruleïne
Anthracene Blue
Anthracene Brown
Alizarine Yellow A and C.

I. Dyeing process by steaming.

1. Boiling.

In order to thoroughly cleanse and moisten the cotton, it is well boiled for two hours in suitable vats or apparatuses with a solution of soda containing 2 to 3 parts of soda for every 1000 parts water, then well washed with clean water, hydro-extracted squeezed, or wrung out.

For very brilliant red the yarn must also be bleached.

2. First mordant.

The boiled cotton is worked in a bath of

Acetate of alumina 9° Tw.

or

Basic sulphate of alumina 9° Tw.

till it is thoroughly and evenly penetrated by the mordant; it is then quickly wrung out, squeezed or hydro-extracted, and dried at a temperature of 120° F. for 24 hours.

3. *Oiling.*

A solution of

10 parts Turkey-red oil F (sulphoricinoleate) in
90 » water

is prepared, and the goods worked in it till they are thoroughly and evenly soaked by the liquid. They are then quickly and well wrung out, squeezed or hydro-extracted, and dried at a temperature of 140°—160° F. for 12 hours.

4. *Second mordant with alumina.*

This is carried out in the same manner as described under No. 2.

5. *Chalking.*

The dried mordanted goods are worked in a bath which contains

1/2 part chalk and
100 parts water

at 85°—105° F. for about half an hour, and then washed well with clean water.

For producing claret shades with a mixture of Alizarine Red and Anthracene Blue this chalk-bath is replaced by one containing 1 part phosphate of soda in 100 parts water.

6. *Dyeing.*

The water used for dyeing should shew at least 5 German degrees of hardness, and the temperature of the bath on entering the goods must not exceed 68° to 77° F.

Stir the dyestuff —

6% to 15% Alizarine paste 20%,

according to the depth of shade required with about 10 times its weight of clean water and add it through a fine brass or hair sieve to the dye-bath. The damp goods are now entered and worked for about 20 minutes cold, and then during the space of about half an hour the temperature is raised to 140° to 150° F. and kept at this point for about an hour. After this the goods are removed from the bath, rinsed and wrung, squeezed or hydro-extracted.

Coeruleïne requires water as free as possible from lime and also an addition of 20 parts Turkey-red oil F for every 1000 parts dye-bath.

In using a mixture of Anthracene Blue and Alizarine Red for claret shades, one adds 1/2 lb. of a 20% solution of ammonia for every 100 gall. of dye-liquor, which has the effect of producing more even dyeing.

7. *Oiling.*

The cotton is oiled and dried as described under No. 3.

8. *Steaming.*

The cotton is steamed in the steaming apparatus for one to two hours at a pressure of 1/2 to 1 atmosphere or for two to three hours without pressure, and then washed well.

9. Brightening.

The cotton is boiled in an open or closed apparatus for $^1/_2$ to 1 hour (according to shade), with a soap solution containing 5 parts soap for every 1000 parts water, and then well washed and dried at not too high a temperature.

For yellow shade Alizarine (scarlet) the brightening must not be done in a boiling bath, but at 140° F.

This process is especially adapted for producing brilliant blue and scarlet shades of Turkey-red, but can also be employed for the above-named Alizarine Colours.

II. Simplified dyeing process

(without steaming).

1. Boiling
2. First Mordant
3. Oiling
4. Second mordant
5. Chalking

are carried out in the same way as described under method I.

6. Dyeing.

For Alizarine Red add to the dye-bath in addition to the dyestuff 3% to 8% Turkey-red oil F (according to the quantity of dyestuff used), then heat slowly during $^1/_2$ hour to the boil, which continue for 1 hour. The addition of Turkey-red oil is not necessary for the other Alizarine Colours.

7. Oiling
8. Steaming

are omitted, and

9. Brightening

is carried out as described under method I.

This simplified process, however, does not yield such brilliant and beautiful red shades when using Alizarine and Purpurine as the first process, but it can be recommended for the following dyes which do not require steaming.

Alizarine Orange
Alizarine Maroon
Anthracene Blue
Coeruleïne
Anthracene Brown
Alizarine Yellow A and C.

No. 2. (No. 396.)

Short process for dyeing

Alizarine Colours on cotton using alumina mordant.

(Turkey-red dyeing without oil preparation.)

Only the following brands are adapted for dyeing cotton (yarn and cloth) on alumina mordant: —

Alizarine paste
Purpurine
Alizarine Orange
Alizarine Maroon
Coeruleïne
Anthracene Blue
Anthracene Brown
Alizarine Yellow A and C.

1. *Boiling.*

In order to thoroughly cleanse and moisten the yarn or cloth, it is well boiled for two hours in suitable vats or apparatuses with a solution containing 2 to 3 parts soda ash for every 1000 parts of water, then washed well with clean water, hydro-extracted, squeezed or wrung out.

2. *Sumaching.*

Work the goods well in a decoction prepared from

5	parts	sumac leaves and
100	»	hot water

and leave them immersed in it for 12 hours, then wring, squeeze, or hydro-extract, and proceed to mordant without washing.

3. *Mordanting.*

Work the cotton in a bath of

Acetate of alumina 9° Tw.

or

basic sulphate of alumina 9° Tw.

until it is thoroughly and completely penetrated by the liquid, then well wring, squeeze, or hydro-extract, and, dry at a temperature of about 120° F. for 24 hours.

4. *Chalking.*

The mordanted goods are entered in the dry state into a bath containing

$^1/_2$ part chalk
100 parts water

and worked well for about half an hour at 85° to 105° F., and then washed well in clean water.

5. *Dyeing.*

Water used for dyeing should show at least 5 German degrees of hardness, and the temperature of the bath when the goods are entered should not exceed 68—77° F.

Stir the dyestuff —

6 % to 15 % Alizarine paste 20 % —

with about 10 times its weight of clean water, and add it through a fine sieve to the dye-bath along with

3 % to 8 % Turkey-red oil F.

The goods are then entered and worked cold for about 20 minutes, heated up slowly within half an hour to the boil, and maintained at this temperature for 1 hour. Finally rinse well, wring, etc.

6. *Brightening.*

The cotton is boiled for $^1/_2$ to 1 hour (according to shade) with a solution of 5 parts soap in 1000 parts water then well washed and dried at not too high a temperature.

The yellow shade Alizarines (scarlets) are brightened at 140° F., and not boiling.

This process can be used for Alizarine Red where cheaper and not very brilliant dyeings are required. The other Alizarine Colours mentioned above can also be dyed by this method.

No. 3. (No. 423.)

Directions for dyeing

Cotton with Alizarine Colours on an alumina mordant.

(Turkey-red dyeing with aluminate of soda.)

Only the following Alizarine Colours are suitable for dyeing cotton (yarn and cloth) according to this process: —

Alizarine paste
Purpurine
Alizarine Orange
Alizarine Maroon
Coeruleïne
Anthracene Blue
Anthracene Brown
Alizarine Yellow A and C.

1. Boiling.

In order to thoroughly cleanse and moisten the cotton (yarn or cloth), it is well boiled for 2 hours in suitable vats or apparatuses with a solution of 2—3 parts soda ash in 1000 parts water, then washed with clean water, hydro-extracted, squeezed, or wrung out.

For very brilliant red the yarn must also be bleached.

2. Mordanting.

The mordanting bath is prepared by dissolving

1 part aluminate of soda (commercial, containing about 45 % Al_2O_3)
in 5 parts hot water.

This solution is allowed to stand till the red-brown precipitate of oxide of iron (which is contained in greater or lesser quantity in commercial aluminate of soda) has settled down. The clear liquid is poured off and adjusted if required by addition of clean water to show 23° Tw.

25 parts of Turkey-red oil F are now stirred into every
75 » of aluminate of soda 23° Tw.

and the mordant must then shew 18° Tw.

In working with closely-woven material which is difficult to dye through, 5 parts of Alizarine paste for every 1000 parts of mordant are added to the aluminate of soda, in which it dissolves, and thus penetrates the fibre completely in the mordanting operation. It is then fixed in the dyeing operation.

The goods are worked well in this bath till they are thoroughly and evenly penetrated by the liquid, then quickly wrung out, squeezed, or hydro-extracted, and well dried at 105°—125° F. This operation must be carefully and uniformly carried out, and care must be taken that no drops of water fall on the goods during the drying which would give rise to stains.

The alumina is fixed on the fibre by working the goods quickly and evenly for 10 minutes in a cold bath containing

1 part sal ammoniac (chloride of ammonia) in
100 parts water.

Finally wash well.

The aluminate of soda bath can be used again, but the fixing bath (sal ammoniac solution) must always be prepared fresh.

3. Dyeing.

The water used for dyeing must contain a certain amount of lime, and too soft water up to 5° hardness requires an addition of 2—4% acetate of lime (calculated on the quantity of dyestuff employed). Harder water of 8° and more is neutralized by adding 1 to 2 parts acetic acid 9° Tw. (30%) for every 1000 parts of water (according to hardness).

The dyestuff: 6—15% (according to required shade) is stirred with about 10 times its weight of clean water and added through a fine sieve to the dye-bath. The goods are then entered and worked for ¼ hour in the cold, and then slowly heated during ½ hour to 140—150° F. and kept for 1 hour at this temperature, and then well washed, wrung, or hydro-extracted.

In case the now ensuing oiling and steaming operations should be omitted, add further

1—3% Turkey-red oil F

to the dye-bath (according to the quantity of dyestuff used), and work for ¼ hour cold, and then raise during ½ hour to boiling and boil for 1 hour. Then wash and wring out, etc.

4. Oiling.

Work the cotton without previous drying in a bath containing

10 parts Turkey-red oil F in
90 » water

wring well out and dry.

The oiling operation is omitted if the dyeing is done at the boil.

5. Steaming.

The oiled cotton is steamed for 1 hour at a pressure of 1 atmosphere in a steaming apparatus, or for two hours without pressure.

The steaming operation is omitted if the dyeing has been done at the boil.

6. Brightening.

The cotton is brightened by boiling for $\frac{1}{2}$ to 1 hour (according to shade) in brightening apparatus with a solution containing

5 parts soap in
1000 » water,

and then well washed and dried.

For yellow shades of Alizarine (scarlet) the brightening is done at 140° F.

This process is suitable for all the above-mentioned Alizarine Colours, but is only used for piece-dyeing in special cases.

No. 4. (No. 1004.)

Directions for dyeing

Cotton light shades (Pink) with Alizarine Colours on a mordant of alumina.

1. Boiling.

In order to thoroughly cleanse and moisten the cotton (yarn and cloth), it is well boiled for two hours in suitable vats or apparatuses with a solution of 2—3 parts soda ash in 1000 parts water. It is then well washed with clean water, wrung, or hydro-extracted.

2. Bleaching.

For light shades (Pink) it is advisable to bleach the yarn with bleaching powder, or by the electric process.

3. First mordant.

The boiled and bleached cotton is worked till it is thoroughly and evenly penetrated by liquid in a bath of

Acetate of alumina $4^1/_2$° Tw.

or

Basic sulphate of alumina $4^1/_2$° Tw.

then quickly wrung, squeezed, or hydro-extracted, and dried at about 122° F. for 24 hours.

4. Oiling.

The cotton is worked till thoroughly and evenly penetrated by the liquid in a bath containing

10 parts Turkey-red oil F in
200 » water

then sharply squeezed, wrung, or hydro-extracted, and dried at 122° F. for 24 hours.

5. Second mordant

is performed as described under 3.

6. Chalking.

The dried mordanted cotton is worked well at a temperature of 85—105° F. for $^1/_2$ hour in a bath containing

$^1/_2$ part chalk in
100 parts water

and then well washed in clean water.

7. Dyeing.

The cotton is entered in a cold dye-bath containing

$^1/_2$—5% Alizarine 20%
$^1/_4$—2$^1/_2$% Turkey-red oil F,

worked for $^1/_4$ hour cold, and then slowly heated up to 140—150° F., and maintained at that temperature for 1 hour. Finally wash well.

8. Steaming.

Steam the cotton for 1 hour at a pressure of $^1/_2$ atmosphere, or for 2 hours without pressure, in a steaming apparatus.

9. Brightening.

The cotton is brightened by boiling $^1/_2$—1 hour (according to shade) in a solution of

5 parts soap in
1000 » water

and then well washed and dried.

The yellow shades of Alizarine (scarlet) are brightened at a temperature of 140° F.

This process is especially adapted for the blue shades of Alizarine *(V brands)*, which yield a fine bluish pink. The yellow shades *(G brands)*, as well as the other Alizarine Colours mentioned above, can also be dyed according to this process.

It is also suited for dyeing loose cotton.

No. 5. (No. 404, 404 a.)

Directions for dyeing

Cotton with Alizarine Colours on an iron mordant.

1. Boiling.

The cotton (yarn or cloth) is thoroughly cleansed and moistened by boiling in suitable vats or apparatuses with a solution of 2—3 parts soda in 1000 parts water for two hours. It is then well washed with clean water, wrung, squeezed, or hydro-extracted.

2. Oiling.

The cotton is worked till completely and evenly penetrated in a bath of

10 parts Turkey-red oil F
150 » water

then wrung, or hydro-extracted, and dried at 140—160° F.

It is not absolutely necessary to oil the cotton, but the fastness and beauty of the colours are increased by doing so.

3. Mordanting.

The cotton is now well worked in a bath of

Acetate of iron,

the strength of which is regulated according to the depth of shade required; for full rich shades the mordant should stand at about 12° Tw. The goods are then well wrung out, and allowed to hang for 2—3 days in the open air or oxidizing rooms till the oxide of iron is well fixed.

4. Chalking.

The cotton is well worked in a bath containing

5—10 parts whitening in
1000 » water,

for 1/2 hour at a temperature of 140—160° F., and then well washed.

5. Dyeing.

The dyestuff—

5—15 % Alizarine paste 20 %,—and
2 1/2—7 1/2 % Turkey-red oil F

are well stirred with about 10 times its weight of water and then passed through a fine sieve into the dye-bath, which should have a temperature of about 86° F. The cotton is then entered and worked for about 1/4 hour cold, heated gradually during 3/4 hour to boil and kept boiling for 1 hour, and finally washed well.

6. Soaping (Brightening).

The dyed cotton is boiled with a solution of

3 parts soap in
1000 » water

and then well washed.

The iron mordant is often used in combination with an alumina mordant. In this case the yarn is treated before oiling with a solution of

Acetate of alumina 9° Tw.

as described under method 1.

No. 6. (No. 399, 409, 430.)

Directions for dyeing

Cotton with Alizarine Colours on chrome mordant.

I. Mordant of chloride of chrome
II. Mordant of acetate of chrome
III. Alkaline chrome mordant
IV. Mordant of bisulphite of chrome.

1. *Boiling.*

The cotton (yarn or cloth) is well moistened by boiling for 1—2 hours in suitable vats or apparatuses with a solution of 2—3 parts of soda ash in 1000 parts water; it is then washed with clean water, wrung, or hydro-extracted.

2. *Mordanting.*

I. Chloride of chrome mordant.

The chloride of chrome mordant serves for producing light, dark, or medium shades on cotton yarn or cloth.

The mordanting is done with

Chloride of chrome 32° Tw. B. A. S. F.,

and one or other of the following methods is employed depending on whether light, medium, or dark, brilliant or dull shades are required.

a) For light shades.

(Up to about 5 % dyestuff.)

The boiled cotton is turned and wrung out several times in

Chloride of chrome 32° Tw. B. A. S. F.

contained in a wooden vat, until it is thoroughly and evenly penetrated by the mordant, and then immersed therein for 12 hours (over night). It is now well wrung, squeezed, or hydro-extracted, and well washed in running hard calcareous water.

b) For medium and brilliant shades.

The boiled cotton is well turned and wrung out several times in

Chloride of chrome 32° Tw. B. A. S. F.

contained in a wooden vat, until it is thoroughly and evenly penetrated by the liquid, and then left immersed in the mordant for 12 hours (over night). It is now wrung or hydro-extracted and well washed in running hard calcareous water. It is now well worked while still damp in a bath of

10 parts Turkey-red oil F
90 » water

until it is thoroughly and evenly penetrated by the oil, then wrung out or hydro-extracted, and well dried at 120—140° F.

The cotton is now turned again for a few times in the bath of

Chloride of chrome 32° Tw. B. A. S. F.

and allowed to remain immersed in it for 4 hours.

It is now well wrung out or hydro-extracted, and washed in running hard calcareous water.

c) For less brilliant dark shades.

The boiled cotton is turned and wrung for a few times in

Chloride of chrome 32° Tw. B. A. S. F.

contained in a wooden vat, until thoroughly and evenly penetrated by the liquid, and allowed to remain immersed in it for 12 hours (over night). It is then well wrung out or hydro-extracted, and well washed in running hard calcareous water.

The cotton is now entered while still damp in a bath of

10 parts Turkey-red oil F
90 » water

and well worked until thoroughly and evenly penetrated by the liquid, then wrung out or hydro-extracted, and well dried at 120—140° F.

The cotton is now placed in a boiling bath prepared from

1 part sumac-extract 52° Tw.

— or the equivalent quantity of sumac leaves —

and 100 parts water,

and allowed to remain there 12 hours (over night), without heating the bath further. Now wring well or hydro-extract, and without washing or drying, enter into a bath of

Chloride of chrome 32° Tw. B. A. S. F.

Turn well and leave immersed in the bath for 4 hours and then wring etc., wash well in running hard calcareous water. The mordanting baths can be repeatedly used, the chloride of chrome bath being readjusted to its original strength by adding

Chloride of chrome 52° Tw.

and the Turkey-red oil and sumac baths by addition of Turkey-red oil and sumac-extract or leaves respectively.

The chloride of chrome mordant is sometimes combined with an alumina mordant, and in this case the second chloride of chrome bath is replaced by one of acetate of alumina 9° Tw. and carried out as in method 1.

II. Acetate of chrome mordant.

Acetate of chrome is principally used for mordanting cotton yarn or cloth used for dyeing light shades, and is less suited for the production of medium and dark shades.

a) Boiling with diluted solutions of acetate of chrome.

The cotton is well worked in a boiling solution of

2 · 2 1/2 parts acetate of chrome 32° Tw. B. A. S. F.
100 » water

for 1 hour and then well washed.

This process is especially adapted for yarn.

b) Steeping in acetate of chrome 32° Tw. and steaming.

The cotton is padded with a solution of

Acetate of chrome 32° Tw. B. A. S. F.,

then dried and steamed for 1 hour at a pressure of 1/2 atmosphere, or for 2 hours without pressure, and finally washed well.

This process is especially suited for mordanting piece-goods.

If necessary the acetate of chrome can be used repeatedly, being brought up to its original strength by addition of acetate of chrome 52° Tw.

An oil preparation can be applied previous to either of the two mordanting methods, but is not, however, necessary.

III. Alkaline chrome mordant.

The alkaline chrome mordant can be used as mordant for all Alizarine Colours to produce the most varied shades, and is particularly suited for Alizarine Black.

The mordant is prepared from

25	parts	acetate of chrome 32° Tw. B. A. S. F.
32	»	soda-lye 72° Tw.
1	»	glycerine 52° Tw.
42	»	cold water
100	parts	showing about 32° Tw.

The glycerine is added to prevent the formation of insoluble hydrated oxide of chrome on standing.

The cotton is well turned several times in this solution and left there over night (12 hours); it is then well wrung or hydro-extracted and washed in running hard calcareous water.

The bath can be used repeatedly after being replenished by adequate quantities of acetate of chrome, soda-lye, and glycerine.

Since the mordant is strongly alkaline India rubber gloves must be used, or the cotton must be worked on rods.

No. 7. (No. 414.)

Directions for dyeing

Cotton with Alizarine Colours in one bath.

1. Boiling.

The cotton (yarn or cloth) is well moistened and cleansed by boiling it 1—2 hours in suitable vats or apparatuses with a solution of 2—3 parts soda ash in every 1000 parts of water. It is then well washed in clean water, wrung, or hydro-extracted.

2. Bleaching.

The cotton is bleached in the usual manner with bleaching powder or by the electric method.

3. Dyeing.

Prepare a cold dye-bath with

3 % alum
1/2—3 % dyestuff;

or with

3 % acetate of chrome 32° Tw. B. A. S. F.
1/2—3 % dyestuff.

The cotton is worked in this bath for 1/4 hour cold, and then heated slowly during 3/4 hour to boiling which is continued for 1 hour, and then the cotton is well washed.

4. Soaping.

The dyed cotton is soaped for 10 minutes at 140—160° F. with a solution of

2 parts soap
1000 » water.

The shades got when dyeing with alum are more brilliant but not so fast to light as those got when dyeing with acetate of chrome.

No. 8. (No. 373.)

Directions for padding

Cotton with Alizarine Colours on a chrome mordant.

1. Boiling.

In order to thoroughly moisten and cleanse the cotton (loose cotton, yarn or cloth), it is boiled for 1—2 hours in suitable vats or apparatuses with a solution of 2—3 parts soda ash in 1000 parts water, then well washed with clean water, wrung, squeezed, or hydro-extracted.

2. Padding.

Prepare a solution of

1 part Alizarine Colour in powder
8 parts cold clean water as free as possible from lime,

or of

3 parts Alizarine Colours in paste
6 » cold water

and add to these solutions

1 part acetate of chrome 32° Tw. B. A. S. F.

For light shades an adequate quantity of water is added, whereas for dark shades the quantity of dyestuff and mordant is increased or starch thickening is added to the bath which causes more dye to be fixed on the fibre.

The cotton is steeped in the above solution, wrung, squeezed, or hydro-extracted, and dried, care being taken that the temperature does not exceed 104° F.

The solutions wrung out or hydro-extracted from the goods are collected, as they may be used again.

3. Steaming.

The cotton is steamed 1 hour at a pressure of $^1/_2$ atmosphere, or for 2 hours without pressure and then well washed.

4. Soaping.

The cotton is soaped at the boil with a solution of

2 parts soap in
1000 » water.

Only the following Alizarine Colours are adapted for this process: —

Alizarine Blue S paste
» » S powder
» Indigo Blue S paste
» Green S paste
Coeruleïne S paste
» S powder
Alizarine Black S paste
» » SR paste
» » SRA paste.

No. 9. (No. 402.)

Directions for dyeing

Alizarine Colours on cotton previously printed with mordants.

The cleansed and bleached cotton cloth is printed with the following mordants:

For Red with Alizarine:

3	lbs.	acetate of alumina 15° Tw.
7	»	starch thickening
10	lbs.	

For Violet with Alizarine:

4	lbs.	acetate of iron 12° Tw.
6	»	starch thickening
10	lbs.	

For Claret with Alizarine Red, and for all other Alizarine Colours:

4	lbs.	bisulphite of chrome 48° Tw. B.A.S.F.
6	»	starch thickening
10	lbs.	

For Brown with Anthracene Brown:

2	lbs.	acetate of alumina 15° Tw.
1	lb.	acetate of iron 12° Tw.
7	lbs.	starch thickening
10	lbs.	

and also other combinations of these mordants.

These quantities are meant for full deep shades, and if lighter shades are required the quantity of mordant is proportionately reduced.

Cloth printed with alumina and iron must be well dried and allowed to hang for 48 hours in the oxidizing room.

After the mordants have been fixed, the goods are chalked at a temperature of 122° F. for 1/4 hour in a bath of

5—10	parts	whitening
1000	»	water.

Chrome mordant is also fixed by hanging, but it is also recommended to give the goods a short steaming without pressure (in the Mather-Platt apparatus) after they have been dried.

The dyestuff, the quantity of which must be regulated according to the printed design and the depth of shade, is stirred with 10 times its weight of water, and added through a fine sieve to the cold dye-bath.

For alumina and iron mordants, a further addition of Turkey-red oil is required amounting to half the weight of the dyestuff employed, and in the case of chrome mordant an addition of 3 lbs. acetate of ammonia for every 100 gall. of liquor in the dye-bath.

The goods are worked for $^1/_4$ hour cold and then slowly heated up within $^3/_4$ hour to boiling, which is continued for 1 hour. Alizarine Red on alumina mordant can also be dyed at a temperature of 140—150° F. and fixed by steaming.

In dyeing with chrome-mordanted cotton 3 lbs. acetic acid 9° Tw. (30%) are slowly added to the dye-bath after $^1/_4$ hours boiling. After dyeing wash well, and soap.

No. 10. (No. 393$^1/_2$, 401.)

Directions for dyeing

Cotton with Alizarine Colours on discharged mordant.

I. Alumina and Iron mordant.

The boiled and bleached cotton is padded with

Acetate of alumina 7—15° Tw.

for red and pink, and with

Acetate of iron 6—12° Tw.

for violet, and with combinations of these mordants for compound shades.

If the goods are required to be dyed on one side only print on a mordant of

1—3 lbs. acetate of alumina 15° Tw.
9—7 » starch thickening
10 lbs.

or

1—4 lbs. acetate of iron 12° Tw.
9—6 » starch thickening
10 lbs.

according to the shade desired.

After a short drying at a low temperature print-on a discharge composed of

1—2 lbs. citric acid
9—8 » starch thickening
10 lbs.

(according to the strength of the mordant), dry, and allow to hang for 48 hours in the oxidizing room.

The cloth is now treated $^1/_4$ hour at a temperature of 120° F. (for iron mordant 140—160° F.) in a bath containing

5—10 parts whitening
1000 » hot water.

The dyestuff, the quantity of which is regulated according to the pattern and depth of the desired shade, is stirred with 10 times its quantity of water, and added through a fine sieve to the dye-bath to which also Turkey-red oil equal to half the weight of the employed dyestuff is added. The cloth is worked for $^1/_4$ hour cold, and then slowly raised within $^3/_4$ hour to the boil which is then continued for 1 hour.

The dyeing can also be done at a temperature of 140—150° F. but in this case the colour must be developed by steaming.

The cloth is now washed and soaped, and in the case of Alizarine Red passed through a bath of bleaching powder shewing 1$^1/_2$° Tw. in order to produce a clean white.

II. Chrome mordant.

The boiled and bleached cloth is padded with a solution of

2 gall. bisulphite of chrome 48° Tw. B. A. S. F.
6 » water
2 » gum tragacanth solution (60 : 1000),

for light shades proportionately less quantities of chrome are required.

If the cloth is only to be dyed on one side, print-on a mordant of

1—3 lbs. bisulphite of chrome 48° Tw. B. A. S. F.
9—7 » starch thickening
10 lbs.

according to the shade required, and dry at 85—105° F.

The discharge is prepared with

$1^1/_2$ lbs. bisulphate of soda
4 oz. citric acid
8 lbs. 4 » starch thickening
10 lbs.

After printing dry and steam in a continuous steaming apparatus (Mather-Platt) for a short time without pressure.

Now work for $^1/_4$ hour in a solution of

10 lbs. carbonate of ammonia
100 gall. water (120° F.)

and then wash well.

The requisite quantity of the dyestuff is stirred with about 10 times its weight of water and passed through a fine sieve into the dye-bath along with

3 lbs. acetate of ammonia B. A. S. F.

for every 100 gall. of water. The goods are now entered and worked for $^1/_4$ hour cold and heated within $^3/_4$ hour to the boil. After boiling $^1/_2$ hour add gradually

3 lbs. acetic acid 9° Tw. (30 %)

diluted with water, for every

100 gall. of water

present, and continue boiling for 1 hour.

Finally the goods are washed and soaped.

No. 11. (No. 374, 375, 392, 403, 421.)

Directions for printing

Alizarine Colours on cotton yarn and cloth.

a) Cotton cloth.

The cotton cloth is boiled-off with soda, etc. in the usual way and then padded with a solution of

7 lbs.	Turkey-red oil D
4 oz.	ammonia 20 $^0/_0$
10 gall.	water

then well dried at a temperature of 120° F. for 12 to 24 hours.

For Alizarine Red, Purpurine, Alizarine Orange, Alizarine Maroon, Coeruleïne, and Galleïne, a preparation with Turkey-red oil is necessary, but it can be dispensed with for the remaining Alizarine Colours.

Thickening.

Starch thickening is employed for darker shades and gum solution for lighter colours.

Starch thickening.

2 lbs.	starch
5 »	gum tragacanth paste (60 : 1000)
1 lb. 4 oz.	olive oil
2 gall.	water

are stirred together while cold, then boiled till a uniform pulp is formed and the mass kept stirred till cold, and finally passed through a fine sieve.

Gum thickening.

1 lb.	gum arabic
1 »	water

are let soak for 12 hours, then dissolved by heating on the water-bath and when cool squeezed through a fine cotton cloth.

Printing Colours.

Alizarine Red.

1. **Red** (alumina mordant).

15 lbs.	Alizarine 20 $^0/_0$
$9^1/_2$ »	acetate of lime 15° Tw.
9 »	sulphocyanide of alumina 32° Tw.
$8^1/_2$ »	mordant OX (oxalate of tin 25° Tw.)
58 »	starch thickening
100 lbs.	

2. **Pink** (alumina mordant).

$^3/_4$	lb.	Alizarine 20 %
$^3/_4$	»	acetate of lime 15° Tw.
$^3/_4$	»	sulphocyanide of alumina 32° Tw.
1	»	mordant OX (oxalate of tin 25° Tw.)
$96^1/_4$	lbs.	gum thickening
$99^1/_2$	lbs.	

3. **Claret** (chrome mordant).

10	lbs.	Alizarine 20 %
4		acetate of lime 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
9	»	acetate of chrome B. A. S. F. 32° Tw.
72	»	starch thickening
100	lbs.	

4. **Violet** (iron mordant).

5	lbs.	Alizarine 20 % (blue shade)
$7^1/_2$	»	acetate of lime 15° Tw.
25		acetic acid 9° Tw. (30 %)
$2^1/_2$	»	acetate of iron 23° Tw.
60	»	starch thickening
100	lbs.	

Purpurine.

5. **Red** (alumina mordant).

$12^1/_2$	lbs.	Purpurine 20 %
$6^1/_2$	»	acetate of lime 15° Tw.
$6^1/_2$	»	sulphocyanide of alumina 32° Tw.
$74^1/_2$	»	starch thickening
100	lbs.	

6. **Claret** (chrome mordant).

$12^1/_2$	lbs.	Purpurine 20 %
$2^1/_2$		acetate of lime 15° Tw.
6		acetic acid 9° Tw. (30 %)
6		acetate of chrome 32° Tw. B. A. S. F.
73		starch thickening
100	lbs.	

Alizarine Orange.

7. **Orange** (alumina mordant).

20	lbs.	Alizarine Orange 15 %
5	»	acetate of lime 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
20	»	acetate of alumina 15° Tw.
50	»	starch thickening
100	lbs.	

8. **Brown** (chrome mordant).

20	lbs.	Alizarine Orange 15 %
5	»	acetic acid 9° Tw. (30 %)
10	»	acetate of chrome 32° Tw. B. A. S. F.
65	»	starch thickening
100	lbs.	

Alizarine Maroon.

9. **Claret** (alumina mordant).

15	lbs.	Alizarine Maroon 20 %
5	»	acetate of lime 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
15	»	sulphocyanide of alumina 32° Tw.
60	»	starch thickening
100	lbs.	

10. **Claret** (chrome mordant).

15	lbs.	Alizarine Maroon 20 %
5	»	acetic acid 9° Tw. (30 %)
10	»	acetate of chrome 32° Tw. B. A. S. F.
70	»	starch thickening
100	lbs.	

Alizarine Blue.

11. **Alizarine Blue S paste and SR paste** (chrome mordant).

20	lbs.	Alizarine Blue S paste
5	»	acetate of chrome 32° Tw. B. A. S. F.
75	»	starch thickening
100	lbs.	

12. **Alizarine Blue S powder and S R powder** (chrome mordant).

5 lbs. Alizarine Blue S powder dissolved in
15 » cold water
5 » acetate of chrome 32° Tw. B. A. S. F.
75 » starch thickening
100 lbs.

13. **Alizarine Blue** (zinc mordant).

20 lbs. Alizarine Blue S paste
or 7 lbs. Alizarine Blue S powder dissolved in
13 » water
5 » bisulphite of zinc 32° Tw. B. A. S. F.
75 » starch thickening
100 lbs.

14. **Alizarine Blue** (nickel mordant)

20 lbs. Alizarine Blue S paste
or 7 lbs. Alizarine Blue S powder dissolved in
13 » water
5 » acetate of nickel 15° Tw.
75 » starch thickening
100 lbs.

15. **Alizarine Indigo Blue** (chrome mordant).

20 lbs. Alizarine Indigo Blue S paste
5 » acetate of chrome 32° Tw. B. A. S. F.
75 » starch thickening
100 lbs.

16. **Alizarine Green** (chrome mordant).

20 lbs. Alizarine Green S paste
5 » acetate of chrome 32° Tw. B. A. S. F.
75 » starch thickening
100 lbs.

17. **Anthracene Blue R, B, G, G G and G extra** (alumina mordant).

20 lbs. Anthracene Blue } are boiled and
54 » starch thickening } stirred till cold
5 » glycerine
6 » acetic acid 9° Tw. (30 %)
15 » acetate of alumina 15° Tw.
100 lbs.

18. **Anthracene Blue R, B, G, G G and G extra** (chrome mordant).

20 lbs. Anthracene Blue } are boiled and
63 » starch thickening } stirred till cold
5 » glycerine
6 » acetic acid 9° Tw. (30 %)
6 » acetate of chrome 32° Tw. B. A. S. F.
100 lbs.

19. **Anthracene Brown** (chrome mordant).

15	lbs.	Anthracene Brown paste
5	»	acetic acid 9° Tw. 30 %
10	»	acetate of chrome 32° Tw. B. A. S. F.
70	»	starch thickening
100	lbs.	

20. **Galleïne** (chrome mordant).

30	lbs.	Galleïne in paste
5	»	acetate of chrome 32° Tw. B. A. S. F.
65	»	gum thickening
100	lbs.	

21. **Coeruleïne S paste** (chrome mordant).

20	lbs.	Coeruleïne S paste
5	»	acetate of chrome 32° Tw. B. A. S. F.
75	»	starch thickening
100	lbs.	

22. **Coeruleïne S powder** (chrome mordant).

5	lbs.	Coeruleïne S powder dissolved in
20	»	cold water
5	»	acetate of chrome 32° Tw. B. A. S. F.
70	»	starch thickening
100	lbs.	

23. **Galloflavine** (chrome mordant).

10	lbs.	Galloflavine
5	»	acetic acid 9° Tw. (30 %)
2	»	acetate of chrome 32° Tw. B. A. S. F.
83	»	starch thickening
100	lbs.	

24. **Alizarine Black S paste, SR paste, SRA paste** (chrome mordant).

25	lbs.	Alizarine Black S paste, SR paste, SRA paste
5	»	acetic acid 9° Tw. (30 %)
5	»	acetate of chrome 32° Tw. B. A. S. F.
65	»	starch thickening
100	lbs.	

25. **Alizarine Yellow A and C** (alumina mordant).

$12^{1}/_{2}$	lbs.	Alizarine Yellow A, C 20 %
5	»	acetate of lime 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
10	»	sulphocyanide of alumina 32° Tw.
$67^{1}/_{2}$	»	starch thickening
100	lbs.	

26. Mordant Yellow G and R (chrome mordant).

2 lbs.	Mordant Yellow dissolved in
18	water
5	acetic acid 9° Tw. (30 %)
10	acetate of chrome 32° Tw. B. A. S. F.
65	starch thickening
100 lbs.	

Lighter shades are obtained by increasing the amount of thickening; compound shades by combining the above printing colours.

Steaming.

The printed goods are well dried and then steamed for 1 hour at a pressure of 1/2 atmosphere, or for 2 hours without pressure.

Alizarine Red and Pink.

In this case the steamed cotton must be chalked before washing by working for 1 minute in a bath containing

2 1/2 parts	whitening
100 »	water

at a temperature of 175° F., and then washing well.

It is now soaped for 1/2 hour at the boil in a bath containing

3 parts	soap
2 1/2 »	soda crystals
1 1/4 »	tin-salt
1000 »	water

and then well washed and dried.

The other Alizarine Colours do not require this chalking operation; after having been washed well the goods are soaped for 1/4 hour at 120° F. with a solution of

3 parts	soap in
1000 »	water.

b) "Ombré" printing on Cotton yarn.

The yarn is boiled with soda in the usual manner and then printed in a bleached or an unbleached condition.

The process is carried out in exactly the same way as for cotton cloth, except that in the printing colour for

Alizarine Red and Pink,
Purpurine, Alizarine Maroon, and Alizarine Yellow A and C

with alumina mordant, the sulphocyanide of alumina is replaced by acetate of alumina as the former injures the yarn.

The printing colours are prepared as follows: —

Alizarine Red (alumina mordant).

15	lbs.	Alizarine 20 %
10	»	acetate of lime 15° Tw.
18	»	acetate of alumina 15° Tw.
8	»	mordant OX (oxalate of tin 25° Tw.)
49	»	thickening
100	lbs.	

Alizarine Pink (alumina mordant).

1	lb.	Alizarine V1 new 20 %
¾	»	acetate of lime 15° Tw.
1¼	»	acetate of alumina 15° Tw.
½	»	mordant OX (oxalate of tin 25° Tw.)
96½	lbs.	thickening
100	lbs.	

Purpurine (alumina mordant).

12½	lbs.	Purpurine 20 %
6½	»	acetate of lime 15° Tw.
13	»	acetate of alumina 15° Tw.
68	»	thickening
100	lbs.	

Alizarine Maroon (alumina mordant).

15	lbs.	Alizarine Maroon 20 %
5	»	acetate of lime 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
25	»	acetate of alumina 15° Tw.
50	»	thickening
100	lbs.	

Alizarine Yellow A and C (alumina mordant).

12½	lbs.	Alizarine Yellow A, C 20 %
5	»	acetate of lime 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
20	»	acetate of alumina 15° Tw.
57½	»	thickening
100	lbs.	

No. 12. (No. 393, 400.)

Directions for discharging

Alizarine Colours on Cotton.

1. Acid Discharge paste.

The same acid discharge is used for discharging Turkey-red as for dyed or steam red or violet on alumina or iron mordant.

The cotton is dyed or printed with Alizarine Colours according to one of the usual methods, and discharged by printing on the following mixture: —

10 lbs.	citric acid
10 »	tartaric acid
80 »	starch thickening
100 lbs.	

After printing the goods are dried at about 105° F., and then treated with a bleaching powder solution of $4\,{}^1/_2$° Tw. Care must, however, be taken in using this method, or the material will be effected both by the acids and the chlorine.

2. Alkaline Discharge paste.

This discharge is especially suited for Turkey-red.

The Alizarine dyed cotton is printed with a discharge of

35 lbs.	soda-lye 82° Tw.
15 »	silicate of soda 77° Tw.
50 »	starch thickening
100 lbs.	

then dried, and steamed for 1 hour at $^1/_4$ atmosphere pressure. It is now well washed in hot water, and passed through a cold bath containing

5—10 lbs. sulphuric acid 168° Tw. in
100 gall. water,

and then thoroughly washed and soaped.

3. Oxidizing Discharge pastes.

These pastes are especially suitable for discharging light and medium shades of

Alizarine Blue
Alizarine Indigo Blue
Alizarine Green
Alizarine Black
Coeruleïne
Anthracene Brown

on chrome mordant.

They are not so well adapted for discharging dark shades, or for the other Alizarine Colours.

The discharging agents used are: —

I. **bromate of potash,**

II. **chlorate of potash and chlorate of soda in conjunction with red prussiate of potash (potassium ferricyanide).**

The goods can be oiled before dyeing or printing; they are then dyed, printed, or padded with the Alizarine Colours omitting in the two latter instances to fix by steaming.

The cloth is printed with one of the following discharge pastes: —

I. Discharge with bromate of potash.

3—10	lbs.	bromate of potash — in a finely powdered state — dissolved in
97—90	»	starch thickening,

according to the depth of shade to be discharged.

II. Discharging with chlorate of potash, chlorate of soda and red prussiate of potash.

12	lbs.	British gum are boiled with
$1\frac{1}{2}$	gall.	water

and then cooled to about 120° F., and to this is added

1	lb.	chlorate of potash (finely powdered)
1	»	chlorate of soda (» »).

Stir the mixture till cold and add

$10\frac{1}{4}$	lbs.	red prussiate of potash (finely powdered)
21	»	carbonate of magnesia (about 40 % paste).

Print, dry, and steam for 1—2 hours, which is best done in a continuous steaming apparatus (Mather-Platt), and finally wash and soap.

B.

Linen (flax), hemp, jute, ramie, china grass, etc.

THESE vegetable fibres are used in the dyed condition for various purposes of the textile industry. They can be dyed or printed with the Alizarine Colours in exactly the same way as cotton.

C.

Wool.

WOOL was extensively used even at the remotest age, both in its natural and dyed condition, for producing the most varied textile fabrics. The comparatively high price of wool and the great demands made regarding the colours, have at all times caused the production of fast colours on wool to be a very important branch of dyeing. For this purpose the dyer had formerly at his command only the natural colouring matters, such as *indigo, madder, logwood, fustic, red-wood, archil, Persian berries, sanders-wood, caliatour, camwood, cochineal,* etc. However, since the introduction of the Alizarine Colours, his choice of dyes has been increased by a great number of colouring matters which have gained favour with the dyer in a continually increasing degree on account of their easy and reliable application, their extraordinary fastness, and their cheapness.

Wool is dyed in all the various stages of its manufacture which will be briefly described in the following.

Loose Wool.

The farming of sheep and other wool or similar fibre producing animals, is carried on almost all over the world, although some countries such as South America, Australia, South Africa, and also Spain, England, Russia, Hungary, and Germany have the main share in the production of wool.

Real wool, i. e. sheep wool, varies greatly in quality according to the breed of the sheep and their conditions of life. The hair may be long or short, coarse or fine, smooth or curled, and it also differs greatly in regard to firmness, elasticity, and durability of the fibre. All these properties have a great influence on the dyeing operation, also the application of the various kinds of wool to the textile industry depends on them. There are, however, quite a number of other wool producing animals which must give up their coat for use in the textile industry. For instance, mohair wool comes from the angora goat, a native of Turkey, etc., the cashmere wool from a species of goat in Thibet, and also the hair of camels, lamas, calves, cows, etc., is employed for producing textile fabrics. The hair of rabbits and hares is also used to a great extent in the manufacture of hats.

Wool is dyed to a great extent in the loose state, especially wool which is intended for the manufacture of cloths which are expected to shew great resistance against the various influences in practical use.

Slubbing, Noils.

Slubbing is obtained by combing the long-haired kinds of loose wool, and the shorter fibres so obtained are called noils.

Slubbing is worked into yarn both in the dyed and undyed condition, and the combings are used in mixture with wool for producing textile goods.

Woollen Yarn.

Loose wool is worked up into yarn both in the dyed and undyed condition, and two principal kinds of yarn are distinguished, viz: —

Carded yarn
Worsted yarn.

Carded yarn is formed by working both the long and short fibres up together, whereas worsted yarn is prepared exclusively from the long fibres, slubbing.

The different sorts of loose wool and other textile fibres of animal origin, yield yarns of varied quality and fineness which serve the different demands of the textile industry.

Among these may be mentioned: —

Carded yarns, made from different qualities of wool and used in the manufacture of all kinds of wearing cloths.

Worsted yarns, which serve the same purpose.

Knitting yarns, used for producing knitted goods.

Mohair yarns, used for plush, decorative threads, fancy goods, etc.

It is, however, not only the quality of the wool, but also the twist and thickness of yarn that exercise a great influence in dyeing.

Woollen Cloths.

Yarn is woven into all kinds of cloth which is used for the most varied purposes the following kinds of cloth are distinguished according to the sort of yarn used: -

Carded goods
Worsted goods
Plush, velvet, damask, etc.

Wool and Fur-Hats.

Wool as well as hair from rabbits and hares is used in the manufacture of hats, being transformed into a close felt by a milling process.

The material for hats is dyed partly as finished felt, partly in a semi-milled, and partly in the loose condition.

Woollen Felt.

For many cases wool is worked into felt, and in this case is mostly dyed in the piece.

Shoddy.

This much praised and also much abused material is used for the manufacture of cheap wearing cloths and in a steadily increasing degree. It is obtained by the rending ("devilling") and carding of worn woollen materials and waste of cloth factories, and is worked up alone or in combination with loose wool or cotton.

Shoddy may be dyed either as loose wool, or as yarn, or in the piece. Like cotton, wool must be thoroughly cleansed before dyeing, as it is necessary for obtaining good results.

If insufficiently cleansed wool is dyed, the Alizarine Colours combine with the fat present and yield dyeings which rub off badly and are also not fast to milling.

(The behaviour of indigo-dyed wool is particularly noticeable in this respect if impure wool has been used.)

A thorough scouring of the wool is of the greatest importance for successful dyeing with Alizarine Colours.

Cleansing of Wool.

Loose Wool.

The raw wool as it is shorn from the sheep contains a quantity of grease, the so-called yolk, which varies from 30—80 % depending upon the species of the animal, and the conditions under which it has been living. This yolk consists of soluble potash salts and fatty substances. In addition to this yolk the wool contains more or less mechanical contaminations such as dust, excrement, and vegetable particles (burs).

The grease and other impurities are removed by

Washing the Wool.

The above-mentioned fatty potash salts are soap-like substances soluble in water, and are partly removed when the sheep are washed before shearing, and partly by the preliminary washing of the wool after shearing.

The wool, however, after these washings is far from being as pure as it is required, and therefore on entering the factory is subjected to another cleansing process. This is done by soaking the wool at a temperature of 115° F. in a solution of soap and soda, which partly dissolves and partly emulsifies the yolk. After this it is better to squeeze out the wool between rollers, and then enter it in a second bath of soap and soda so as to remove the last remnants of the yolk, etc.; it is then finally washed in suitable washing machines with plenty of clean water.

The number and concentration of the soap-baths used, also the length of time the wool is treated in them is regulated by the degree of impurity of the wool.

The temperature of the washing baths must not exceed 115° F., and it is well known that the rinsing of the wool is best done with entirely cold water.

As already mentioned, the lime contained in water combines with the soap to form an insoluble fatty lime soap. In the case of cotton-dyeing, it was pointed out that the only disadvantage of this lime is that it causes an increased consumption of soap, but in the wool industry this hardness of the water has a much greater influence, as during the scouring of the wool the lime salt formed settles on the fibre producing disturbances in dyeing.

From this it is evident that the softest water is the best for washing wool, and if possible that which is free from lime (purified) should be used.

Slubbing.

As a rule slubbing is sufficiently pure as it reaches the dyers hands, having already gone through the washing operation before spinning, and therefore in most cases it is not necessary to cleanse slubbing before dyeing.

Woollen Yarn.

Wool worked into yarn, has already been subjected to the washing operation before spinning, and is therefore free from yolk, etc. But in order to render it more fit for spinning, it is impregnated with oil, and this must be removed before dyeing.

The spinning oils chiefly used, are fatty acids which are readily soluble in alkalies (soda), for instance saponified olive oil (Oleïne). Other vegetable oils are also used, both in the unsaponified and in their original condition. The application of mineral oils, distillation products of petroleum, etc. must be studiously avoided, as they do not saponify or dissolve in soda, and it is therefore difficult to completely remove them from the wool. In addition to this they have an injurious effect on the colours in milling. The saving which is made by using these oils which are recommended to the spinner under the most various names, is more than counterbalanced by the difficulties they produce in dyeing the wool.

The washing of the yarn, i. e. the removal of the spinning oils, is best done in wooden becks with warm solutions of soda and soap, or of ammonia and soap. The soap has the same effect as in the case of loose wool of forming an emulsion with the fats and other impurities. The conditions of working depend entirely upon the nature and quantity of the spinning oils and quality of the yarn. Calcareous water exerts the same influence upon the result of the washing as is does with loose wool. After the soaping, the yarn is well washed by rinsing in clean water and then dried in appropriate drying machines, or it can be dyed immediately without drying.

The dyer is urgently recommended to rinse the dried yarn before dyeing in clean hot water to which a little ammonia has been added, even though they have been previously scoured and appear to be clean enough; this precaution will be more than repaid by the good results obtained in dyeing.

Woollen Cloths.

In cloth weaving establishments the yarn is worked up in the oiled condition if the goods are to remain white or if they have been dyed in the loose wool, and in a cleansed state if they have been dyed in the yarn. In either case the warp is glued and dressed in order to made it durable. This spinning oil and dressing is removed by washing the cloth on leaving the loom in washing machines with water containing some soda, and finally thoroughly washing with water. If the goods require milling, the milling operation follows this washing process and conforms with the quality of the cloth; after this the goods are well washed with clean water.

In all cases it is better to boil the cloth for $^1/_2$ hour before dyeing with some clean water to which a little ammonia has been added, to make quite sure that all impurities are removed from the cloth.

Woollen Felt.

Wool-felt is produced from cleansed wool by felting with soap or acids, which are afterwards washed out with water.

Wool and Fur-Hats.

These are also produced by felting the cleansed material, and in most cases acids are used; they only require boiling out with clean water before dyeing.

The Alizarine Colours are chiefly fixed on wool by dyeing, and only rarely by printing; slubbing, however, is frequently printed according to the "Vigoureux" system, and also woollen yarn ("Ombré"). In the following details will be given of the different methods employed; the wool branch being divided like that of cotton into two sections, viz: —

I. Wool-dyeing

II. Wool-printing.

I. Wool-Dyeing.

THE processes for dyeing wool in the loose material, yarn, cloth, etc. with Alizarine Colours, are quite similar to those used for madder, logwood, or fustic. The wool is impregnated with metallic salts by suitable treatment with mordants, which combine with the Alizarine Colours in the ensuing dyeing operation to form coloured Alizarine lakes.

The number of metallic oxides, however, which are suitable for mordants has shrunk down to two, only

Alumina mordant

and

Chrome mordant

being well adapted for fixing Alizarine Colours on wool.

Owing to its chemical constitution, the wool fibre possesses a much greater affinity for the mordants and also for the Alizarine Colours than cotton, and so the dyeing of wool may be considered rather simple as compared with cotton-dyeing.

Whereas in mordanting cotton a certain number of baths are required to fix enough alumina, chrome, etc. on the fibre, in mordanting wool it is sufficient to subject the material to one simple boiling process.

The union of mordant and dyestuff takes place in the dye-bath by gradually raising the temperature to boiling, and in this manner the Alizarine Colours dye the fibre slowly and evenly.

It is absolutely necessary to keep the dye-bath boiling for some time after it has been exhausted, or the colour lake will not be completely fixed on the fibre, and also its good properties will not be developed.

1. Alizarine Colours on alumina mordant.

Alumina salts have the tendency when in aqueous solutions, and especially at a raised temperature to turn into basic salts, due to part of the acid being liberated.

This dissociation extends still further in the presence of wool, alumina separating out which immediately combines with the wool fibre. On account of this rapid dissociation, the alumina is apt to settle unevenly on the fibre, which is prevented by addition of organic acids or their salts, such as tartaric or oxalic acids, to the mordanting bath.

These additions retard the mordanting process by forming alumina salts of the respective acids, which being more stable, liberate the alumina more slowly during the boiling.

It is also advisable to begin the mordanting operation at a low temperature, say about 85° F., and slowly heat up within about $^1/_2$ hour to boiling, which must then be continued for 1—1$^1/_2$ hours.

Potash alum is almost exclusively used as alumina mordant for wool, more rarely sulphate of alumina. The following proportions have been found serviceable for practical working: —

10 % alum
3 % tartar
2 % oxalic acid.

For lighter shades these quantities are reduced to: —

5 % alum
1½ % tartar
1 % oxalic acid.

According to the material, the mordanting baths must contain 30—50 times more water than wool, and if more water must be used it is advisable to increase the quantity of the mordanting materials. The time required for mordanting is about 1½ hours, after which time the wool is thoroughly washed to get rid of excess of mordants, which otherwise would cause the dyeings to rub off and lead to other unpleasantness.

The amount of lime present in the water, is of minor importance in mordanting with alumina, as the acidity of the bath prevents the lime from doing any damage. If the water be uncommonly hard, say 15° to 20°, it is corrected by adding 1 lb. acetic acid 9° Tw. (30 %) for every 100 gall. water.

The presence of iron in water is very injurious in using alumina mordant, as some of the oxide of iron is fixed along with the alumina on the wool, and forms the dark iron lake with the Alizarine Colours, and thus strongly saddens the brilliant shades of the alumina lakes. It is therefore advisable not to use water containing considerable amounts of iron for Alizarine Colours on alumina mordant without first removing the iron. For the same reason the mordanting materials, i. e. alum, tartar, oxalic acid, etc. should be free from iron.

All the Alizarine Colours can be fixed on an alumina mordant, but only a small part of the colour lakes so produced, have the good properties of dyeing wool fast colours.

The most valuable for dyeing wool on an alumina mordant are: —

Alizarine Red paste
» » S powder
Alizarine Orange
Alizarine Maroon.

The various brands of

Anthracene Blue

can be used for shading purposes. All the other Alizarine Colours are not suited for dyeing on an alumina mordant.

The above-stated Alizarine dyestuffs serve principally for producing orange and red shades, the latter of which resemble madder, but are much purer and more brilliant.

It is a well-known fact, that dyeings done with madder on alumina mordant, resist milling better than those got with artificial Alizarine, and are also not so apt to turn in shade although both have been produced under exactly the same conditions. This remarkable phenomenon may be explained as follows: —

Turkey-red on cotton, dyed with Alizarine Red on alumina mordant, requires the presence of lime salts and fats (Turkey-red oil) for the complete development of all its good properties, and a fine Turkey-red cannot be got without the aid of these substances.

On the other hand the analysis of madder shows that it contains in addition to the dyestuff certain quantities of lime salts, fats, and tannin. Now an analysis of Turkey-red dyeings on cotton, and of madder dyeings on wool proves the presence of lime and fats in both cases, the colour is an Alizarine-alumina-lime-fat-lake. The part played by the fats and tannin in dyeing with madder, has, however, not yet been reliably ascertained.

From this it may be concluded, that the above-stated additions are necessary, in dyeing wool with Alizarine on alumina mordant, and indeed a red is obtained which is quite as fast to milling as madder red by adding acetate of lime, soap and tannin to the dye-bath.

The various paste brands of Alizarine Red, Alizarine Orange and Alizarine Maroon, require only these additions, whereas

Alizarine Red S

must be fixed in an acid bath, and therefore an adequate quantity of acetic acid is added to the dye-bath.

The various brands of

Anthracene Blue

are best dyed in a neutral bath without any addition.

The dyeing should be started in a cool bath of about 85° F., as at a higher temperature the Alizarine Colours are too rapidly absorbed by the fibre, and are therefore apt to yield uneven shades. The dyestuff is dissolved in the requisite amount of water, and added to the dye-bath which is then slowly heated to the boil, and then boiled for 1½ to 2½ hours according to the depth of the shade. This long continuation of the boiling is necessary for the complete fixation of the colour, and must not be omitted even if the bath appears exhausted before the end of the time, care must also be taken that the bath actually boils and that the boiling is maintained.

The additions of acetate of lime, soap and tannin are used especially for loose wool which is usually subjected to a severe milling process. In dyeing yarn and piece-goods it is advisable to omit the addition of soap, as otherwise there is a risk of the dyeings rubbing-off.

The amount of lime in the water has of course no influence in the dyeing operation with Alizarine Red, since a larger amount of an acetate of lime is intentionally added to the bath. However when dyeing with Alizarine Red S powder, the addition of acetic acid must be increased when dyeing with very hard water.

The presence of iron in the water is detrimental as in the mordanting operation, since it gives rise to the formation of Alizarine iron lakes.

The wool is often mordanted and dyed in copper vessels, but this is, however, not very suitable when dyeing Alizarine Colours on an alumina mordant, as the copper darkens the shade owing to the formation of the brown Alizarine copper lake. It is, therefore, advisable to dye in tinned copper vessels or in wooden vats.

2. Alizarine Colours on chrome mordant.

The alumina mordant is the most important in cotton dyeing, whereas in wool dyeing the chrome mordant is of the greatest importance. The majority of Alizarine Colours can only be dyed fast shades on wool with the help of a chrome mordant, and are extensively used in opposition to the natural dyestuffs, indigo, logwood, madder, fustic, sanders-wood, etc.

As already mentioned the wool fibre has more attraction for mordants and dyestuffs than cotton, and in the mordanting process wool absorbs oxide of chrome very easily, and binds it firmly. This combination of wool with oxide of chrome takes place by simply treating the wool with oxide of chrome salts just as is the case with alumina, but the principal mordant used in wool dyeing is

Bichromate of potash.

Bichromate of soda is quite as serviceable and equally good, but since it is hygroscopic it must not be kept in damp store rooms.

The chemical process in mordanting wool with bichromate of potash is as follows: —

When wool is boiled in an aqueous solution of bichromate of potash, it absorbs and enters into fast combination with part of the chromic acid, and neutral chromate of potash remains behind in the bath. The amount of chromic acid absorbed by the wool is increased by adding some mineral acid to the bath, such as sulphuric acid, or some acid salt as bisulphite of soda, since they liberate chromic acid from the neutral chromate of potash.

The impurities contained in the wool, and perhaps also the constituents of the wool itself, reduce part of the chromic acid to oxide of chrome during the boiling process. This combines with the unreduced part of the chromic acid to form chromate of chromium, and it is in this form that the chrome appears on the wool fibre in mordanting with bichromate of potash and sulphuric acid or bisulphate of soda, thereby rendering the wool yellow. Since the Alizarine chrome lakes are compounds of oxide of chrome with Alizarine colouring matters, it follows that in dyeing wool which has been mordanted by the above method the chromic acid is also reduced to oxide of chrome, and in this case the reduction must take place at the expense of the dyestuff.

In fact the results got by dyeing some Alizarine Colours which are very sensitive to oxidizing agents on this mordant, are somewhat inferior to those obtained with mordants which will be referred to later on.

In order to prevent this action of chromic acid and to fix the chrome on the fibre as chromium oxide, an addition of organic substances is made to the dye-bath, which are gradually oxidized by the chromic acid during the boiling causing the latter to be reduced to oxide of chrome, which forms a fast combination with the wool fibre colouring it at the same time greenish grey.

Tartar
(bitartrate of potash)

has been long known and used for this purpose in logwood dyeing. The tartaric acid it contains, is oxidized by the chromic acid which is at the same time reduced to oxide of chrome.

A similar effect to that of tartar is obtained by using other organic acids and acid salts such as: —

Tartaric acid, which on account of its high price will scarcely be used, and

Oxalic acid, which is largely used as a cheap substitute for tartar.

Lactic acid

has recently been recommended as a reducing agent for the chrome mordant, and is quite as suitable as tartar for the purpose. In using any of the above-mentioned additions, only a part of the chromic acid in the bichromate of potash used is fixed on the fibre.

The firm of C. H. BOEHRINGER SOHN of Nieder-Ingelheim, manufacturers of lactic acid, have published and patented an improved chrome-mordanting process, by which the total amount of bichromate of potash in the dye-bath can be reduced to oxide of chrome, and at the same time fixed on the fibre.

This is attained by using suitable quantities of bichromate of potash, sulphuric acid and lactic acid; chromic acid is liberated by the sulphuric acid and then reduced to oxide of chrome by the lactic acid.

The above-mentioned firm have recently recommended the bilactate of potash as an addition to the mordanting bath under the name of

Lactoline,

the effect of which is quite similar to that of tartar.

A good many substitutes are in the market for the above-stated mordanting bath additions, which are not so good as those mentioned above, and in most cases the prices charged for them are much above their real value.

The following which are mixtures of varying quantities of oxalic acid, Glauber's salt, bisulphate of soda, Epsom salts, etc. may be mentioned: —

Redarine
Tartarine
Tartar substitute
Wool salt
Veradine
Crematine.

The saving attained by using such mordants is only an illusive one and therefore, tartar, oxalic acid and lactic acid deserve preference.

The mordant which is probably most used at the present time consists of

Bichromate of potash—tartar

used in the proportion of

3 % bichromate of potash
2 ½ % tartar.

For dyeing many Alizarine Colours dark shades the quantities must be increased to

4 % bichromate of potash
3 % tartar
} strong chrome mordant,

whereas a reduction is advisable for light shades to

1 % bichromate of potash
1 % tartar
} weak chrome mordant.

Reviewing the various substitutes for tartar the following proportions are arrived at: —

Bichromate of potash—sulphuric acid 168° Tw.

3 % bichromate of potash
1 % sulphuric acid 168° Tw.

4 % bichromate of potash
1½ % sulphuric acid 168° Tw.
} strong chrome mordant.

The sulphuric acid combination is not adapted for use as a "weak chrome mordant" for light shades.

Bichromate of potash—oxalic acid.

3 % bichromate of potash
1½ % oxalic acid

4 % bichromate of potash 2 % oxalic acid	strong chrome mordant
1 % bichromate of potash ½ % oxalic acid	weak chrome mordant.

Bichromate of potash—lactic acid (50 %).

3 % bichromate of potash
2½ % lactic acid

4 % bichromate of potash 3 % lactic acid	strong chrome mordant
1 % bichromate of potash 1 % lactic acid	weak chrome mordant.

Bichromate of potash—lactic acid—sulphuric acid.

1½ % bichromate of potash
3 % lactic acid
1½ % sulphuric acid 168° Tw.

Most Alizarine Colours furnish the same shade on these different mordants, with the exception of Anthracene Blue, in which case the shade is influenced by the mordant. For example with the acid mordants:—

bichromate of potash—oxalic acid
bichromate of potash—lactic acid
bichromate of potash—lactic acid—sulphuric acid

the shade is turned towards green. The bichromate of potash—sulphuric acid cannot be recommended for Anthracene Blue.

As already mentioned, the salts of oxide of chrome give up part of their chrome oxide to the wool fibre on boiling. Although bichromate of potash is used as a mordant in by far the majority of cases, yet **fluoride of chrome** in conjunction with **oxalic acid** is used for many purposes as a mordant. This mordant is not equally suitable for all Alizarine Colours, but is specially suited for light brilliant shades and for dyeing on a light indigo ground which would be injured to a certain extent by a bichromate of potash mordant.

The following proportions are suitable:—

4 % fluoride of chrome
2 % oxalic acid.

Acetate of chrome is also employed as a mordant for the one-bath process. In carrying out the mordanting operation, the tartar and bichromate of potash or whatever other addition is used, are separately dissolved in hot water and these solutions are then added to the mordanting bath. It is quite necessary that the two mordants be separately dissolved, as otherwise they would react on each other forming salts of oxide of chrome, thereby becoming unfit for mordanting.

Dyers frequently prepare the mordanting baths with boiling water, but it is better to start at a low temperature and heat up slowly, lest the oxide of chrome be too quickly fixed on the fibre. In the case of piece-goods it would tend to cause uneven mordanting, also the pieces would not be sufficiently penetrated, and the result would be uneven dyed and badly "hearted" goods. This is particularly the case in using a bichromate of potash—lactic acid—sulphuric acid mordant.

The wool (loose wool, yarn, cloth, etc.) is entered, and the bath slowly raised to boiling and kept boiling 1½ hours. At the commencement of the operation it is necessary to keep the goods well moved, in order to obtain a uniform fixation of the oxide of chrome. After the operation is finished, the wool is taken out and well rinsed with clean water.

The mordanted wool is frequently left standing over night in the mordanting liquids or in baskets, but although this proceeding may be recommendable for logwood, etc., it is not necessary for the Alizarine Colours.

In any case, the mordanted wool must be well rinsed (water being poured over it in baskets) in order to remove any mordant which has not been fixed, and which if allowed to remain would cause the unpleasant effects of rubbing-off or unevenness of the finished dyeings. In this case the Alizarine Colours would combine with the chrome in the adhering mordanting liquid to form chrome lakes, which are no longer capable of being fixed on the fibre but become simply attached to it mechanically.

When working with the bichromate of potash—sulphuric acid—lactic acid mordant of Boehringer, this rinsing can be dispensed with, as the whole of the chrome is fixed on the fibre.

The amount of liquid in the mordanting bath should amount to 30—50 times the weight of the wool, the exact amount depending on the nature of the material to be mordanted. If too much mordanting liquor be used it may easily happen that an insufficient quantity of oxide of chrome is fixed on the fibre, and in such cases it is advisable to raise the quantity of mordanting materials.

The mordanting baths can be used several times in succession, only ²/₃ of the original quantity of bichromate of potash and tartar etc. being added, but it is advisable not to used the baths too often, as the impurities, fat, etc. adhering to the wool gradually accumulate in the mordanting bath.

The quantity of lime contained in the water is of minor importance in mordanting with chrome provided the water is not too hard, in which case it must be corrected by addition of acetic acid. The presence of iron has also little influence in this case, and is only apt to cause slight disturbances in dyeing light shades.

The dyeing operation takes place by boiling the mordanted wool with the dyestuff in a separate bath, when the union of the oxide of chrome and dyestuff takes place on the fibre. In this case the lime-contents of the water are of great importance, as although the Alizarine Colours when dyed on alumina mordant require the presence of lime, its presence is unfavourable when using a chrome mordant and the formation of the lime lakes must therefore be avoided. This object is attained by dyeing in a weakly acid bath, in which the formation of lime lakes cannot take place. The bath is acidified by addition of acetic acid 9° Tw. (30 %), the quantity used being regulated by the hardness of the water, and by this means the carbonate of lime present is converted into acetate of lime.

A slight excess of acetic acid prevents the acetate of lime as well as any gypsum that may be present in the water, from combining with the Alizarine Colours. This surplus of acetic acid has also a very beneficial effect upon the formation of the chrome lake, and for this reason when dyeing Alizarine Colours on a chrome mordant, acetic acid is added to the dye-bath, even when quite soft water free from lime is being used.

Practical experience has shewn that the quantities of acetic acid required by the dye-bath are as follows: —

For water up to 5° hardness: —

1 lb. acetic acid 9° Tw. (30 %)

For water of 5—10° hardness: —

2 lbs. acetic acid 9° Tw. (30 %)

For water of 10—15° hardness: —

3 lbs. acetic acid 9° Tw. (30 %)

for every 100 gall. of liquor in the dye-bath.

If still harder water be employed the amount of acetic acid added must be increased accordingly, and in this case it is advisable to test with blue litmus paper, which must be distinctly reddened.

After the dye-bath has been corrected, the colour dissolved in water is added through a fine sieve. As in dyeing on alumina mordant, the initial temperature of the dye-bath should not be too high, say about 85° F., as at a higher temperature the Alizarine Colours are quickly absorbed by the fibre and consequently uneven dyeings are liable to result, and piece-goods are not sufficiently penetrated.

The wool is entered and the bath slowly raised to the boil, which is maintained for 1½ to 2½ hours according to the depth of the shade, finally the goods are taken out and well rinsed.

The long boiling is absolutely necessary for the correct development and fixation of the Alizarine dyes, and even although with most Alizarine Colours the bath is quite exhausted after a short boiling, still the prescribed time must nevertheless be adhered to, and care taken that the bath is actually kept boiling.

The goods should be continually moved during the dyeing for the same reasons as in mordanting, and the dye-bath like the mordanting bath should contain 30—50 times as much water as wool, the exact amount depending upon the material to be dyed.

Most of the Alizarine Colours are completely exhausted and the dye-baths can be repeatedly used, but they ought not to be used too often, for the reasons given with regard to mordanting.

The dyeing and mordanting of wool with Alizarine Colours on a chrome mordant can be done in copper boilers as well as in wooden tubs or vats; for details of which refer to the chapter on

"Dye-vats and dyeing machines."

All Alizarine Colours can be dyed on a chrome mordant with the exception of the brands

Alizarine Black S paste
» » SR paste
» » SRA paste

which are adapted for printing only, and

Alizarine Yellow A
» » C

which are only intended for cotton.

The dyeings must to a greater or lesser extent answer the requirement that the wool be evenly dyed, and perfectly penetrated by the dyestuff in all its parts. Loose wool is always carded and thereby equalized after dyeing, and fulfils these conditions when working according to the described process, provided all directions as to cleansing, mordanting and dyeing are accurately carried out.

Usually in dyeing slubbing no great demands are made as to evenness, but the peculiar nature of the material makes a few alterations of the dyeing process necessary. For particulars refer to the chapter

"Dyeing of slubbing with Alizarine Colours."

With woollen yarn however, the threads are expected to be dyed perfectly even and uniform, as any uneven parts would show in the finished cloth. Thick and also strongly corded and twisted yarn must be completely dyed through.

All yarns which are not twisted too much can be dyed medium and dark shades according to the above directions, and the dyeings answer all the above-mentioned requirements, but light shades are apt to turn out uneven, and tightly twisted yarn to be insufficiently penetrated.

Piece-goods must be evenly dyed, that is to say they must not be cloudy, streaky or flecky in colour, and must not have darker edges (lists), and finally the interior of the cloth when cut, should shew the same colour in the interior as on the surface. It is easy to dye cloth evenly with Alizarine Colours dark or medium shades, but in light shades the dyeings are liable to turn out uneven. On the other hand with regard to through-dyeing, it is not a difficult matter with cloth which is not too thick, and especially not too closely woven and milled, or made of tightly twisted yarn, but with a very thick and hard material it is very difficult to obtain through-dyeings.

These considerations lead us to the very important subject of

Even and through-dyeing with Alizarine Colours.

As already stated, the tendency of the Alizarine Colours in special cases to dye the fibre unevenly, or to insufficiently penetrate the goods, depends upon their rapid absorption by the fibre at the boiling point. In most cases this rapid absorption can be prevented by a slow heating of the dye-bath, or by adding the acetic acid necessary for fixing the colour, only after the bath has been boiling some time, and part of the dyestuff has been absorbed by the fibre.

The Alizarine Colours are extracted much more slowly from a neutral bath, or one which is slightly alkaline through the presence of lime, than from an acid bath.

This peculiarity forms the basis of a method recommended by the Badische Anilin- and Soda-Fabrik in 1888 for through- and even-dyeing which has done good service in practice. A weak alkali, for instance acetate of ammonia containing excess of ammonia, is added to the dye-bath, which acts as a solvent for the Alizarine Colours and thereby prevents them from dyeing the fibre. On boiling, the ammonia volatilizes, and the dyestuff thereby slowly becomes insoluble and is fixed at the same rate on the wool.

At the end of the dyeing operation acetic acid is added to the dye-bath, and then the boiling is continued for some time in order to completely fix the dyestuff.

This process is suitable for all Alizarine Colours, and is used for evenly dyeing light shades on yarn and cloth, and for compound colours which are difficult to dye even, as well as for through-dyeing of thick yarn and cloth. It is of especial use for hat dyeing, and has been the means of introducing the Alizarine Colours into this branch.

This process is especially adapted for dyeing Alizarine Colours on a chrome mordant, but can also be applied for an alumina mordant.

One-bath process.

In the processes so far described the wool is first impregnated with the mordant, and then in a second bath united with the dyestuff on the fibre. This division of the process is advisable, as the Alizarine Colours and mordants when boiled together in the same bath, form lakes in the solution instead of on the fibre which can no longer be fixed on the wool, and thus leads to loss of dyestuff and other unpleasantness such as rubbing off, etc.

The endeavours to reduce the expense of dyeing, and to simplify the manual labour, led to experiments which proved that the Alizarine Colours could under certain conditions be dyed in one single bath, by allowing the mordant to act on the wool in the same bath as the dyestuff.

This can be done in three different ways, viz: —

1) by first mordanting and then dyeing in the same bath,
2) by dyeing the unmordanted wool and subsequently mordanting,
3) by adding the mordant and dyestuff at the same time to the dye-bath.

1. First mordanting the wool and then dyeing in the same bath.

According to this process which is suitable for all Alizarine Colours, but only on a chrome mordant, the wool is mordanted in such a manner that at the end the bath contains no chrome which would have a destructive or lake-forming action upon the dyestuff. This end is attained by applying the mordant of *Böhringer* which has already been referred to, consisting of bichromate of potash, lactic and sulphuric acid. A mordanting bath so prepared in which wool has been boiled, contains besides sulphate of potash (resulting from bichromate of potash and sulphuric acid) only very trifling quantities of sulphuric acid, and therefore can be used straight off as a dye-bath after having been cooled down sufficiently. Since the bath as already mentioned contains small quantities of sulphuric acid, the addition of acetic acid during dyeing can be proportionately diminished.

The mordanting and dyeing operations are carried out in exactly the same manner as described for the two baths process.

This method is well suited for slubbing, and can be used for yarn and piece-goods in combination with the acetate of ammonia method, but it is not well suited for loose wool.

2. Dyeing the unmordanted wool and subsequently mordanting.

This process is also only suitable for dyeing with a chrome mordant, and especially for Alizarine Black, Alizarine Red, Alizarine Orange, and Mordant Yellow which are partially absorbed by wool on being boiled with it in presence of acetic acid. The colouring matter is fixed by boiling with bichromate of potash in the same bath, which converts the dyestuff into the chrome lake.

This process is used for producing cheap blacks with Alizarine Black, and a more bluish shade which is frequently required is obtained by topping with Anthracene Blue or Alizarine Blue after boiling, i. e. after the wool has been mordanted with oxide of chrome. This process is also very useful for producing cheap browns, olives, etc. with Alizarine Black, Alizarine Red, Alizarine Orange, and Mordant Yellow, and also for Alizarine Red and Alizarine Orange as bottom for indigo.

In some, cases the Alizarine Colours can be fixed by fluoride of chrome according to this method in place of bichromate of potash, but the majority of colours give less favourable results.

However fluoride of chrome is a very suitable mordant for one Alizarine dyestuff which is specially adapted for piece-dyeing viz: —

Anthracene Blue SWX powder and
SWX extra powder

and it is really the only means of applying these brands.

They are dyed by boiling with acetate of ammonia and oxalic acid, and fixed by continued boiling with fluoride of chrome.

The amount of oxalic acid and fluoride of chrome used, as well as the duration of boiling in the various operations, must be regulated according to the required shade and the nature of the material. For shading purposes *Anthracene Blue WG* and *WG extra*, *Alizarine Red, Alizarine Black*, and *Mordant Yellow* can be used simultaneously with *Anthracene Blue SWX* and *SWX extra.*

This method is especially suited for dyeing piece-goods, but inferior results (specky, uneven dyeings) are obtained with other textile materials.

This method can also be used for dyeing *Alizarine Red S powder, Alizarine Red S paste,* and *Alizarine Orange* on alumina mordant by replacing fluoride of chrome by alum.

3. Simultaneous addition of mordant and dyestuff to the dye-bath.

As already mentioned on various occasions, the Alizarine Colours combine with mordants on boiling to form the respective lakes, which when once formed possess no affinity for the fibre.

For this reason dark shades which require a large amount of dye, cannot be dyed in a rational manner by allowing the mordant and dyestuff to act simultaneously on the wool.

On the other hand, light shades can be dyed very well by this method, as the small amount of dyestuff is fairly rapidly extracted by the fibre, where at the same time, the mordant is fixed and combines with the dyestuff. For this method alumina mordant viz. alum, and chrome mordant, acetate or fluoride of chrome, are employed.

In order to avoid the formation of the lake, in the dye-bath, some acid, as a rule oxalic acid, is added, and the dyeing is effected by slowly heating up the bath and then boiling.

This process can be used for all Alizarine Colours, and is especially suited for yarn and piece-goods, but not so well for loose wool.

Dyeing of slubbing with Alizarine Colours.

Slubbing has a great tendency to felt and therefore special care is required in dyeing it with Alizarine Colours; on this account it is rarely dyed in the unreeled rope form, but if so it is treated in vats like wool yarn and very carefully moved. The bath must not be allowed to boil violently, but must be kept as near the boiling point as possible without bubbling up.

Slubbing is sometimes wound up on reels and dyed by turning these in the dye-vat, and this process is the connecting link with the various forms of mechanical dyeing apparatuses, in which slubbing is dyed in the unreeled state as rope, or in the top.

The principle of all these machines is to pack the slubbing in a suitable manner in cylinders, then force the dyeing liquor to pass through it, and it is an easy matter to obtain even shades on unreeled slubbing in these apparatuses.

However it is mostly dyed in tops or balls, which offer more or less resistance to penetration by the mordanting and dyeing liquors, depending on the tightness of the rolling and so act as a kind of filter through which the mordanting and dyeing liquors have to pass.

The mordant penetrates the goods quite easily, since it is soluble in water, and admits of a uniform mordanting. In the dyeing operation however, with the Alizarine Colours which are more or less difficultly soluble in water, the slubbing acts to a certain extent as a filter, and retains the dyestuff at the place where the liquor enters to an extent depending on how tight the ball is wound, and the solubility of the dyestuff. Hence it follows, that the ball must be rolled as loosely as possible, and that the most soluble dyestuffs should be employed.

All the Alizarine powder brands are soluble in water, and some of the paste brands are soluble enough to be fit for dyeing slubbing. In order to retard the absorption of the dyestuff, the requisite quantity of acetic acid is not added until a large part of the dyestuff has been absorbed by the fibre, i. e. after the bath has been brought to the boil.

The Alizarine Colours are divided into the following groups, according to their properties and behaviour in dyeing on a chrome mordant: —

1. Alkaline soda salts in powder, soluble in water.

Alizarine Red SWB and SWR powder
» » S, SF, SS, SSS powder
Alizarine Orange SW powder
Alizarine Indigo Blue SW powder
» » » SMW powder
Alizarine Green SW powder
Anthracene Blue SWRR, SWR, SWB, SWG extra, SWGG, SWG, SWN powder
Anthracene Dark Blue SW powder
Anthracene Brown SW powder
Galleïne SW powder
Mordant Yellow G and R
Fast Mordant Yellow G
Carbazole Yellow W.

These are completely soluble in water and remain in solution even in boiling water.

2. Bisulphite compounds in paste and powder, soluble in water.

Alizarine Blue SW and SRW paste
» » SW » SRW powder
Alizarine Dark Blue SW paste
» » » SW powder
Alizarine Indigo Blue SW paste
Alizarine Green SW paste
Coeruleïne SW paste
» SW powder.

These brands are completely soluble in water, but are gradually changed into insoluble bodies at a temperature of about 140° F.

3. Dyestuffs in paste rather difficult to dissolve in water.

Alizarine Red WB, WR paste
Alizarine Orange W paste
Alizarine Blue XA paste
Anthracene Blue WG, WG extra paste, WGG paste
Galleïne W paste
Galloflavine W paste
Alizarine Black WR, SW, SRW paste
Alizarine Blue Black W, SW paste.

These are rather difficult to dissolve in water, but gradually go into solution in a neutral dye-bath, and are fixed evenly on the fibre in the same ratio.

4. Dyestuffs in paste and powder, difficult to dissolve in water.

Alizarine Maroon W paste and powder
Alizarine Blue WX, WR, and WN double new paste
Anthracene Blue WRR, WRR extra, WR, WB, WN paste
Anthracene Dark Blue W paste
Anthracene Brown W
Galleïne W powder
Galloflavine W powder
Alizarine Black WR, SW, SRW powder
Alizarine Blue Black W and SW powder.

These brands require an addition of acetate of ammonia or soda to the dye-bath, to render them sufficiently soluble.

The colours of group 1 and 3 can be dyed according to the process for loose wool, since the acetic acid is only added at a later stage of the operation.

The colours of group 2, however, which pass into an insoluble condition at a temperature of 140° F., require a slight alteration of the dyeing process. The bath is heated slowly up to 140° F. and kept at this temperature until the bath appears almost exhausted, and it is not till then that it is heated up to the boil.

The colours of group 4 can be rendered soluble by adding acetate of soda or ammonia, and are then suitable for dyeing slubbing.

In using the above-mentioned Alizarine Colours it is necessary to use the softest water possible, and the best is that which has been purified and is free from lime, as otherwise the lime would combine with the Alizarine Colours to form lakes, which are filtered out by the slubbing and so do not take effect. In this case the water cannot be corrected by addition of acetic acid as is done in open boilers and vats, as the dye-bath must not be acidified.

The exact neutralisation of the lime by means of acetic acid is also of no use, as the soluble acetate or sulphate of lime would also produce lime lakes in a **neutral bath**, and this formation can only be prevented in an **acid bath.**

Some of the Alizarine Colours can however be dyed according to the ordinary process under simultaneous addition of acetic acid.

These are: —

Alizarine Red S powder
Alizarine Blue SW paste and powder
Alizarine Indigo Blue SW paste
Alizarine Green SW paste
Coeruleïne SW paste.

These dyestuffs are not injured by calcareous water as the dye-bath is kept acid from the beginning, and the gradual absorption of the dye is attained by raising the temperature very gradually. A filtration of the dyestuff is impossible, as they are completely soluble in water.

The slubbing after mordanting can be washed out in the same apparatus, but the dyed material must be washed in the lisseuse.

Slubbing can be dyed and mordanted in one bath, according to the method described on page 125 using a **mordant of bichromate of potash, lactic acid, and sulphuric acid.**

Alizarine Colours can also be dyed on alumina mordant in an apparatus under the conditions used for a chrome mordant, and in this case also the water must be as free as possible from lime. The soluble powder brands are most suitable, but the paste brands can also be used. The various additions such as acetate of lime and tannin, and in the case of *Alizarine Red S* acetic acid, are not made until the dye-bath has been brought to the boil, and the addition of soap is altogether omitted.

Dyeing of shoddy with Alizarine Colours.

Shoddy has recently in many cases been dyed with Alizarine Colours, as it is used for manufacturing cheap wearing cloths which require to be fairly fast to light, milling, etc. Shoddy is made from scraps of cloth, worn clothes, etc., either of pure wool or half-wool.

The rags from which shoddy is made are of various colours, and are first sorted according to their colour so as to obtain a uniform material. Nevertheless shoddy is in many cases a many-coloured material, and must undergo a special treatment before dyeing.

The various colours of the separate rags which are mostly very different from each other, are removed and as far as possible stripped, partly to remove colours which do not stand milling, and which would afterwards shew the disagreeable effect of bleeding, and partly to obtain as uniform a ground colour for the material as possible. A light-coloured shoddy has also a greater value than a dark one, as it admits of the production of lighter and more brilliant colours.

This stripping is partially attained by carbonisation, to which process the rags are frequently subjected in order to remove vegetable particles. It is carried out by means of sulphuric acid or gaseous hydrochloric acid, which also acts as a solvent for many dyestuffs which are removed by the subsequent washing with water. Another class of colours are removed by the ensuing neutralisation of the carbonized rags by means of soda, and also another part of the colour is removed when the goods are mordanted by boiling with bichromate of potash and sulphuric acid. However in many cases the goods are subjected to a special treatment with acids and alkalies (soda), which dissolve the colour and thereby remove it from the fibre of the wool.

The method used in stripping shoddy depends entirely on the dyestuff with which it is dyed and on the depth of shade. Wood colours are removed, for example, by means of acids (sulphuric, oxalic, or nitric acid), and acid-dyeing Aniline Colours by means of soda, but for this no general rules can be laid down.

The suitably prepared rags are either dyed as they are, or they are first torn up in the "devil", by which the material is brought into the loose state, and the vegetable particles which have been rendered brittle by carbonisation are removed. In case the rags consist of closely woven cloth, etc., it is not advisable to dye them in the undevilled condition, as they are difficult to dye through and consequently the goods would not be of a uniform colour after devilling.

The dyeing is best done in copper boilers according to the method used for loose wool. The ground colour of the shoddy has, of course, more or less influence on the shade of the dyeings, and a light coloured material must be used when light and brilliant shades are required, whereas dark rags are used for full shades. Clear colours such as blue, red, green, etc., require a material possessing a uniform ground colour.

In many cases where brilliant shades are required, the Alizarine Colours are combined with such Aniline Colours as are fast to milling, for example, *Alkaline Violet, Rhodamine, Blue Green S, Thiazine Red.*

After-chroming of Alizarine dyeings.

Several Alizarine Colours when dyed in very dark shades requiring a large amount of dye, stain interwoven white a little in severe milling. This is especially the case with

Alizarine Red (chrome mordant)
Mordant Yellow G and R
Anthracene Blue WG, WG extra, and WGG.

This unpleasantness is prevented by the so-called after-chroming. This is done by adding

$^1/_2$ to 1 % bichromate of potash

to the dye-bath at the conclusion of the dyeing operation, and then boiling for $^1/_2$ hour longer. Any dyestuff that has not been firmly fixed is converted by the bichromate of potash into a chrome lake, and thereby rendered fast to milling. Of course the shade is somewhat altered by this treatment with chrome, a fact, which must be taken into consideration.

Whitening of the wool.

For a good many purposes the dyer is often required to whiten wool, the natural colour of which is more or less yellow. There are a great number of shades even of white, such as yellowish white, greenish white, pearl white, porcelain white, etc., which are imparted to the wool by a combined bleaching and dyeing process.

Bisulphite of soda

is very well adapted for bleaching wool, its active constituent sulphurous acid, destroying the natural colour of wool by reduction.

The reduced colouring matter is removed by washing the wool, which now being pure white can be dyed in the ensuing dyeing operation to any desired tint.

The bleached wool can be dyed in one bath with the Alizarine Colours, but is more often dyed with the Aniline Colours, as they furnish much purer and more brilliant shades than the Alizarine Colours.

Production of silky gloss and "handle" on Alizarine-dyed woollen yarn.

The following process can be used to give woollen yarn dyed with the Alizarine Colours a silky gloss and "handle":—

The undyed yarn is first subjected to a chloring operation, and then dyed according to the known directions with the Alizarine Colours. The yarn is now soaped and then worked in a weak sulphuric acid bath which has the effect of liberating the fatty acids on the wool fibre, and this in conjunction with the alteration of the fibre by the chloring process produces the desired effect (gloss and "handle").

In the previous pages the various methods have been described by which the Alizarine Colours can be fixed on the wool fibre, and it may be useful to consider more closely the different points of the mordanting and dyeing operations that call for particular attention, and also the behaviour of the Alizarine Colours in the various processes to which they are subjected.

Mechanical treatment of textile goods in dyeing with Alizarine Colours.

As already mentioned, wool is dyed in various stages of manufacture with the Alizarine Colours.

Although the main features of the dyeing process are the same for all textile woollen goods, yet the peculiarity of the latter must be considered in carrying out the dyeing processes.

Loose wool.

In order to obtain even-dyeings the wool must be well worked about both in the mordanting and dyeing operation. However, care must be taken in working with loose wool, as it is very apt to felt if subjected to brisk mechanical movement, and for this reason the mordanting and dyeing baths must not be allowed to boil too violently, as a too energetic action of the steam can also cause a felting of the wool. Therefore the mechanical dyeing machines in which the wool remains motionless while the mordanting and dyeing liquors pass through it offer great advantage in dyeing loose wool.

Slubbing.

Slubbing is still more liable to felting than loose wool, and for this reason is mostly dyed in dyeing machines and very rarely in vats in the rope form.

Woollen yarn.

Woollen yarn shows a greater or lesser tendency to felt, depending upon the quality of the wool and the method of spinning, and therefore requires careful handling. In order to prevent uneven dyeing the yarn must be frequently moved at the beginning of the mordanting and dyeing operations, until the colouring matter is almost absorbed by the fibre. The separate rods for the yarn should also be repeatedly shifted, and also for the sake of producing even-dyeings there should not be too many or too large skeins on one rod.

Woollen cloths.

Woollen cloth also shews a tendency to felting, but to a smaller extent than loose wool or yarn, and depends upon the quality of the wool used, on the twisting and cording of the yarn, and on the manner of weaving. Cloth made from fine and loosely-woven wool naturally requires more care in dyeing than more or less severely milled cloth made from coarse wool. After dyeing the goods must be cooled in cold water to prevent heat crumples. During the whole period of manufacture the goods should never be hung over a rack, but always piled up flat; by observing this precaution a great many failures will be prevented for which often no explanation can be found.

Hat-felt.

Hat-felts made of wool or of hair are so tightly felted that there is no danger of further felting, and therefore no particular precaution is required in the mechanical treatment.

Suitable combinations of Alizarine Colours with each other, or with Aniline and Wood Colours.

Owing to the resemblance in chemical constitution and the similarity of the dyeing properties, the various Alizarine Colours can — with very few exceptions — be well combined with one another, and so thousands of fast shades may be obtained.

The following may be mentioned as suitable combinations: —

For Black, —

Alizarine Black, shaded towards blue black with *Alizarine Blue* and *Anthracene Blue,* and towards deep black with *Coeruleïne* or *Mordant Yellow.*

For Blue, —

Alizarine Blue and *Anthracene Blue* darkened and shaded with *Alizarine Black, Coeruleïne,* and *Alizarine Red.*

For Green, —

Coeruleïne, Alizarine Green, and the greenish *Anthracene Blue brands* shaded with *Mordant Yellow.*

For Red and Claret, —

Alizarine Red paste and *powder, Alizarine Maroon* shaded with *Alizarine Orange* and *Anthracene Blue.*

For Orange, —

Alizarine Orange shaded with *Alizarine Red.*

For Brown and Olive, —

Anthracene Brown shaded with *Alizarine Red, Coeruleïne, Mordant Yellow, Anthracene Blue, Alizarine Blue* or *Alizarine Black* in combination with *Alizarine Red, Mordant Yellow,* etc.

For fancy shades, —

Anthracene Brown in combination with *Coeruleïne, Anthracene Blue, Alizarine Red, Mordant Yellow,* etc.

Alizarine Orange and Coeruleïne are apt to yield somewhat uneven dyeings, but this can however be avoided by not adding the acetic acid to the dye-bath before it has been brought to the boil, but a better combination to use is a mixture of *Anthracene Brown* and *Coeruleïne.*

Alizarine Blue, Alizarine Indigo Blue, Alizarine Green, and also the reddish brands of Anthracene Blue are not suitable for producing greens in combination with yellow dyestuffs; it is much better to use combinations of greenish Anthracene Blue brands and Coeruleïne.

The Alizarine Colours can also be very well dyed together with the various Aniline Colours to increase the brilliancy of the shades.

For example, Rhodamine and Thiazine Red are used in conjunction with Alizarine Red on alumina mordant to produce a brilliant Red; Bluish Green S and Wool Green S with Anthracene Blue and Coeruleïne a vivid Green; Alkali Violet and Acid Violet with Alizarine Blue and Anthracene Blue for brilliant Blue and Violet.

As a rule the Aniline Colours are applied by topping, after the Alizarine Colours have been absorbed by the fibre and are fixed by continued boiling mostly with addition of bisulphate of soda. Of course such dyeings are not so fast as pure Alizarine dyeings, but may be considered very durable on account of the fast ground they possess.

Alizarine dyes can also be combined with all the Wood Colours, and improve the fastness of the latter and at the same time the dyeings so produced are very cheap. For example, a very cheap semi-fast Blue is obtained by a mixture of Galleïne and logwood and a cheap Brown by combining Alizarine Red, logwood and fustic or Mordant Yellow.

These combinations of Alizarine and Wood Colours, are dyed according to the directions given for the Alizarine Colours.

Evenness of dyeings produced with Alizarine Colours.

The Alizarine Colours if correctly treated dye very even shades, and especially if the acetate of ammonia process is used.

The most essential points to be noticed for producing perfectly even shades with Alizarine Colours are the following: —

The wool (loose wool, yarn or cloth) which has to be dyed must be perfectly clean, as impurities such as grease, etc., give rise to uneven mordanting and on that account also to uneven dyeing.

Wool which has been mordanted must never be allowed to lie without first having been washed, so as to prevent the mordant from drying on in spots. Care should also be taken that the unwashed mordanted yarn or cloth should not be allowed to stand for any length of time exposed to direct sunlight, which by causing a reduction of the chromic acid (in the mordanting liquid) would give rise to an uneven separation of chrome oxide on the fibre. Hence it follows that for light and more sensitive shades, the mordant should consist of bichromate of potash and tartar, and not of bichromate of potash and sulphuric acid.

In by far the majority of cases, the dye-bath must be cold when the wool is entered, and then slowly raised to boiling. If the initial temperature of the bath is too high, or if the temperature is raised too quickly, the Alizarine Colours are absorbed too quickly by the fibre, and thus uneven dyeings are produced.

In all stages of manufacture — in the milling, washing, carbonizing, mordanting, etc., of piece-goods, they should always be piled up flat and not hung over a rack, as the washing and mordanting liquids run to the edges and become more concentrated there and thus cause the edges to be darker (lists).

The selvage of piece-goods is often darker than the middle if they have been spread out during the dyeing, but in most cases this can be avoided by dyeing the pieces in the rope form (not spread out).

Defective working of the wool often leads to uneven dyeing, as in this case the dyestuff cannot get quickly enough to all parts of the material, and is therefore unevenly absorbed by it.

The quantity of wool used must not be too great in proportion to the mordanting or dyeing liquors, as in this case the goods cannot be moved briskly enough in the bath.

The proper construction of dyeing boilers, vats or tubs, is of great importance and has a material influence upon the evenness of the dyeings.

Reliability of dyeing with Alizarine Colours.

The Alizarine Colours are always most carefully examined by chemical analysis and dyeing tests before they come into the hands of the consumers. They are invariably furnished in exactly the same quality, and have a great advantage in this respect over the natural dyes: indigo, madder, logwood, fustic, etc. which vary very much in strength and shade according to their origin.

If the Alizarine Colours are properly stored and applied they must always produce the same results. Accurate scales must always be used; is it a great mistake to merely estimate the necessary quantities. The Alizarine Colours do not alter in the least even if stored for some considerable length of time, except if unsuitably stored, in which case the pastes may dry up, or the powder colours absorb moisture, whereas logwood for instance, alters decidedly in quality if kept long.

Shading of Alizarine dyeings.

In dyeing a given pattern to shade so many circumstances must be taken into account that the dyer will often fail to produce the given shade at once. Slight mistakes in weighing the dyestuff or the wool, alterations in the hardness of the water, variations in the quality of the material to be dyed, increased concentration of Alizarine Colour pastes due to drying up, changes in proportion between the quantities of wool and dyestuffs etc., either singly or conjointly, effect differences in the result of the dyeing operation, and therefore the dyer is often compelled to add a second quantity of dyestuff to produce the required shade. In such a case it is necessary to cool the bath down, as at a higher temperature the Alizarine Colours are absorbed very quickly by the fibre and therefore uneven dyeings are apt to result.

In the case of loose wool the bath is cooled down to about 170° F. by running off part of the liquid and adding cold water, then the dyestuff, stirred with about 30 times its weight of cold water, is sprinkled over the wool while the latter is being turned.

In working with yarn it is best to take it out of the bath, which is then cooled to about 120° F., and the dyestuff added with the known precautions. The yarn is now entered and turned at first quickly, and later on a little more slowly.

For piece-goods the bath is cooled down to about 120° F., and the dyestuff stirred with water is gradually added to the compartment between the rear of the bath and the perforated partition and at the same time the reel is run quickly so as to distribute the dyestuff as quickly as possible.

When dyeing yarn or cloth with the acetate of ammonia method, the bath has an acid reaction at the end of the operation, and this acid must be neutralized by adding ammonia but only enough to cause red litmus paper to be slightly blued. The dyestuff is now added and the boiling continued for about $^1/_2$ hour and the quantity of acetic acid necessary to acidify the bath added slowly in small portions.

In all cases the added dyestuff must be fixed by sufficiently long boiling, the duration of which is regulated by the amount of dyestuff added.

When only a little more dyestuff is required to reach the desired shade, the object can be attained by adding level-dyeing aniline or wood colours to the boiling bath without noticeably injuring the fastness of the dyeing.

Stripping of Alizarine Colours.

It is often necessary when too dark or uneven shades have been obtained, to remove part of the colour from the fibre. This is a somewhat difficult operation in consequence of the extreme fastness of the Alizarine Colour lakes to the various chemical reagents. Some of the Alizarine Colours are rather easy to remove, while others such as Alizarine Black and Alizarine Blue, resist even strong acids and alkalies. Warm solutions of acids such as oxalic acid, sulphuric acid, etc., or of alkalies (soda) can be used for stripping; the concentration of these solutions, and consequently the extent to which the stripping can be effected, is, however, limited by the action of these chemicals on the wool fibre itself.

Considering the great number of possible cases, more detailed statements of the method of stripping cannot be made, but the fastness to acids and alkalies of the various Alizarine Colours, gives one some clue as to how to proceed.

Rubbing-off.

If all precautions in scouring, mordanting, and dyeing have been observed, wool dyed with Alizarine Colours must not stain a white cloth or paper which is rubbed with it.

Rubbing-off can be traced back to one or other of the following causes:—

Insufficient cleansing of the material before dyeing.
Imperfect fixation of the chrome, etc., in mordanting.
Insufficient rinsing of the wool after mordanting and dyeing.
To high initial temperature of the dye-bath.
The dye-bath being heated up too quickly.
Too slow or too short boiling in the dye-bath.
Insufficient addition of acetic acid, etc.

Vessels for dyeing.

The proper condition and construction of the dye-boilers and vats, have a great influence on the result of the dyeing operation.

Round copper boilers are best suited for loose wool and are heated either by direct fire or with steam, in the latter instance as double-cased boilers. Copper has an injurious effect on some of the Alizarine Colours, and the simplest way to counteract this is not to polish the boiler bright but only to wash it out well each time after being used, and the layer of oxide which is formed in time protects the dyestuff against the action of the copper.

A good method of preventing this injurious action of copper is to add a little **sulphocyanide of ammonia** to the dye-bath (about 1 part for every 5000 parts of water). Free sulphocyanic acid is liberated by the action of the acetic acid, which at once covers the copper with a very fine firmly-adhering coating of insoluble copper sulphocyanide which thus renders the metal harmless. Of course this process can only be employed when dyeing in a bath acidified with acetic acid, and is of no use when working with acetate of ammonia, or when mordanting with chrome, on account of the oxidation of the sulphocyanide of ammonia by the bichromate of potash.

Yarn is best dyed in rectangular wooden vats, heated by indirect steam by means of a steam pipe placed at the bottom of the vat, over which is placed a perforated false bottom to prevent the bath being too rapidly or unevenly heated. The yarn is placed on rods and worked by hand, and the bath used should be high enough to prevent the yarn from touching the perforated false bottom.

Piece-goods are also best dyed in wooden vats, heated by direct steam by a steam pipe fixed to the wall at the rear of the vat, a perforated partition being placed before the pipe to prevent the bath being heated too quickly and unevenly.

The piece should run over a wooden reel worked by machinery so as to make about 60 rotations a minute at the beginning, and about 30 rotations a minute at the end of the boiling operation. The piece should be worked in such a manner that it ascends at the end where the steam pipe is, and is thus always in motion in the neighbourhood of the entering steam.

Round copper boilers are unsuitable for dyeing piece-goods.

Wool and fur-hats are dyed in copper boilers (similar to those used for loose wool), with direct or indirect steam pipes covered with a perforated false bottom.

Slubbing and loose fur are mostly dyed in machines in order to prevent felting as much as possible.

Mechanical Dyeing Apparatuses.

In the dye-vessels so far described, the wool is moved about in the bath, but in the mechanical dyeing apparatuses it remains stationary and the dye-liquor is caused to pass through the material in a suitable manner. In this way the felting of the wool is prevented and the material very much spared.

The main feature of the mechanical dyeing apparatus i. e. keeping the wool stationary and moving the dyeing liquor, has been carried into effect in the most varied ways in a great number of systems.

Some of these machines are constructed for dyeing loose wool, others for dyeing slubbing in the top, and in the former slubbing can be dyed in an uncoiled condition in the rope.

Of a great variety of systems the following may be mentioned:

Obermaier & Co., Lambrecht.

This firm supplies a machine for dyeing loose wool and slubbing in the rope, as well as a so-called revolving apparatus for dyeing slubbing in tops. The dye-liquor is forced by means of a centrifugal pump to pass through the goods which are packed in copper vessels (cylinders).

Schmidt, Langensalza.

(Maker: U. Pornitz of Chemnitz.)

This apparatus is meant for loose wool, and slubbing in the rope or in the top. The goods are placed in a basket, and the liquid is kept in motion by a winged wheel at the bottom of the apparatus.

Albert Schulze, Schmölln.

(Agent: Louis Dill of Frankfort o. M.)

This machine which serves for dyeing slubbing in tops, consists of a number of cylinders with sieve-bottoms into which the tops are packed, and the liquor is forced to flow through the slubbing from a reservoir.

H. Schirp, Barmen-Rittershausen.

This machine is adapted for dyeing wool and slubbing, and consists of a cylinder into which the material is packed, and a pump which forces the liquor alternately from above downwards, and from below upwards.

Drèze, Dison-Verviers.

(Maker: E. Michaelis, Cottbus.)

In this apparatus the wool is packed in a cylinder with a perforated bottom and the dye-liquor caused to circulate by means of a vertically directed steam jet. The effect of the steam injection can be increased by a centrifugal pump.

Skène & Devallée, Roubaix.

The slubbing in tops is packed in several cylinders with perforated bottoms. The dye-liquor is raised into a channel by means of a pump, whence it runs into the cylinders and through the goods, consequently in this machine the liquid only acts by its own weight.

Harmel frères, Val-des-Bois.

This machine (for slubbing) consists of four double cylinders which revolve on a common axle after the style of swing boats.

These are successively immersed in the dye-liquor which is situated underneath, and retain a part of it which runs out afterwards when the cylinder rises, therefore it is the same in principle as the preceding machine.

Klauder-Weldon.

This apparatus consists of sticks arranged in the form of a rotary wheel, and the slubbing is hung on these sticks in the loose condition and then moved in the dye-bath.

Apart from the above-mentioned systems there are a large number of machines which work on similar principles.

In mordanting and dyeing with all these machines the following conditions must be observed: —

Loose wool must not be too tightly packed into the cylinders, but be laid in as uniformly as possible, and for this reason it is better to first wet the wool with warm water as it can be more evenly packed when in this condition. If the wool is too tightly stamped in, the dyestuffs cannot penetrate uniformly enough, also the wool offers too much resistance to the liquor, which may have an unfavourable effect upon the material.

Slubbing must also not be too tightly wound, or the liquid cannot penetrate it sufficiently and it is better to dye it as rope in the uncoiled state.

In the apparatuses for dyeing yarn, machinery takes the place of manual labour, the yarn being suitably fastened on sticks etc., then worked in the dye-liquor. The Klauder-Weldon apparatus already referred to for slubbing may be mentioned here.

II. Wool-Printing.

IN wool-printing, the Alizarine Colours play a much less important part than they do in cotton-printing, but still in some branches such as slubbing printing, their use is not inconsiderable. They are without exception fixed by steam i. e., the mixture of dyestuff and mordant suitably thickened so as to prevent the colour from running, is printed on to the wool and the colour lake is developed by steaming, then the wool is finally washed to remove excess of printing colour.

The operation of wool-printing varies in several respects from cotton-printing, on account of the peculiar nature of the wool.

The primary condition, perfect purity of the material, is quite as indispensable for wool as for cotton, and the wool is cleansed according to the directions given under wool-dyeing.

The Alizarine Colours can then be printed-on without further preparation of the wool, but the latter is, however, frequently subjected to a

treatment with chlorine

which imparts to the wool fibre more affinity for the dyestuff. For this purpose the wool is worked in a bath containing 10 parts hydrochloric acid 32° Tw. in every 1000 parts water, to which $^1/_4$ gallon ($2^1/_2$ lbs.) of a solution of bleaching powder $1^1/_2$° Tw., or still better a solution of hypochloride of soda $1^1/_2$° Tw. (bleaching powder and soda), for every 1 lb. of wool is gradually added. The wool rapidly absorbs the chlorine without undergoing any noticeable outward alteration, except if too much chlorine be used in which case it becomes somewhat yellowish. After being washed and dried it is ready for printing.

The preparation of the printing colour takes place in just the same way as for cotton-printing; a suitable thickening being made of British gum, starch or dextrine, and the dyestuff and mordant added in the same manner as described for cotton.

Most of the Alizarine Colours in wool-printing are fixed by a chrome mordant, but also in a few cases with an alumina mordant.

In contradistinction to cotton-printing, it is best in wool-printing not to dry the goods after printing, but to steam them while they are still in the moist condition, as in this manner the colours are better developed and are also fuller, purer, and more even. The wool is generally steamed in closed steam-boxes or apparatuses at a pressure of $^1/_4$ to $^1/_2$ atmosphere for about 1 hour. The goods must not be steamed too long or at too high a pressure, as in this case they are liable to assume a yellowish tone.

After steaming the goods are well washed and worked in a weak soap-bath.

All the various kinds of woollen material, such as wool-felt, woollen cloth, etc., can be printed according to this method, but a more important branch for applying the Alizarine Colours is the

Printing of slubbing (Vigoureux),

for producing mixtures.

The object of this method is to only partially dye the slubbing, and then blend the partly dyed and partly undyed fibres by a carding operation. By this method, a more intimate and uniform mixture is obtained than by mixing white and dyed wool together.

Lighter and darker shades are obtained by altering the printing pattern, which consists of stripes of different width, or by varying the quantities of dyestuff in the printing colour.

Slubbing, which as a rule is very clean, can be chlored before printing, but this is not absolutely necessary and must often be dispensed with, as it considerably impairs the fitness of the wool for felting.

British gum or dextrine are used as thickenings, as they can easily be removed from the slubbing by washing.

The printing is done on a special machine, Vigoureux system (the inventor's name) on which the slubbing is combed out to a suitable width, and then passed between a colour and a pressing roller when it absorbs the printing colour from the parts of the former which stand out in relief.

After printing the slubbing is not dried, but at once steamed in the same manner as was described for cotton. It is then washed in a lisseuse first in clean water, and afterwards with a weak soap solution.

The slubbing which has been thus printed is then carded, and so worked up into a mixture which is spun into yarn and mostly used for the manufacture of dress-goods.

The Alizarine Colours have proved to be extremely useful for this special kind of work, on account of being very fast to milling and light, and their application is continually increasing.

The printing of woollen yarn

is being practised in an increasing degree for producing certain effects on woollen goods, are is carried out exactly as described above.

All the Alizarine Colours are adapted for wool-printing, but of Alizarine Black only the *S* and *SR paste* marks are suitable.

Fastness of Alizarine Colours on Wool.

THE great fastness of the Alizarine Colours has secured for them in a comparatively short time a prominent place for dyeing fast colours on wool. Owing to the difference in chemical composition they do not all possess the same degree of fastness, and also the method of dyeing has a material influence on their fastness. It must be particularly pointed out that the dyeing processes found by laboratory experiments, and confirmed by thousands of practical operations, must be exactly carried out or else the best possible results cannot be obtained.

It is a matter of course that the fastness of a colour is closely related to its intensity; light shades not being so fast as dark full shades. It is therefore absolutely necessary in testing the fastness of colours, that comparisons should be made with dyeings of equal depth of tone, and as nearly as possible of equal shade, and the material used should also be the same, or else entirely false opinions will be formed.

In the following the properties of Alizarine Colours as regards their fastness on wool will be more closely considered.

1. Fastness to light.

In testing the fastness to light it is best to use dyeings on cloth, which are hung up in a sunny place both under glass and uncovered, while another pattern is retained for comparison protected from light.

The length of exposure of the colours depends upon the nature of the dyestuff, on the way it has been fixed, on the depth of shade, on the use for which the dyeing is required and the requirements connected therewith.

The Alizarine Colours on wool are remarkable for their great fastness to light, and in this respect are worthy rivals of the old dyestuffs of the vegetable kingdom such as indigo, and in fact greatly surpass most of them, for instance, madder, logwood, sanderswood, etc.

The Alizarine Colours on wool can also be divided into two groups regarding fastness to light, in the same way as with cotton. The first group containing the fastest brands consists of: —

Alizarine Red (alumina and chrome mordant)
Alizarine Orange » » » »
Anthracene Brown
Anthracene Blue
Alizarine Blue
Alizarine Indigo Blue
Alizarine Green
Coeruleïne
Alizarine Black (for black).

The second group contains: —

Alizarine Maroon (alumina and chrome mordant)
Alizarine Black (in light and medium shades)
Galloflavine
Galleïne
Carbazole Yellow W
Mordant Yellow
Wool Yellow.

2. Fastness to water.

The Alizarine Colours are perfectly fast to water, and do not lose any dye or stain interwoven white when treated with it. They also withstand atmospheric influences, rain, snow, etc., and also sea water equally well.

3. Fastness to air and weather.

This is the same as fastness to light and water.

4. Fastness to wear and rubbing.

The continued use of woollen cloth as garments etc., causes the well-known alteration in appearance known as wear, rubbing-off, etc., especially at the places exposed to wear, for instance at the seams, button holes, etc. This unpleasant property is especially noticeable in the case of indigo, but is, however, not shown by the Alizarine Colours, due to the Alizarine Colours being perfectly fixed on the fibre by forming a very fast combination with the mordants, whereas indigo is not so firmly fixed. Of course it is necessary to take care in dyeing piece-goods with the Alizarine Colours that they are completely dyed through, as otherwise they would also wear white.

5. Fastness to milling.

Wool possesses the property of felting when subjected to mechanical action i. e. the structure changes and the wool becomes more or less dense, to an extent depending upon the kind of treatment. This property is made use of in

milling,

to obtain more or less stout textures, cloths and hat-felt.

This felting is carried out with solutions of alkalies, soap, soda, etc., i. e. **soap milling,** or with acids, sulphuric acid, i. e. **acid milling,** and is very much promoted by a raised temperature.

Wool is milled partly in the dyed, and partly in the undyed state.

Soap milling.

As already mentioned with reference to the cleansing of woollen stuffs, the cloth as it leaves the loom is washed with a warm solution of soap and soda, in order to remove spinning oil, dressing, and impurities. The milling operation is then proceeded with in machines of the most varied construction with the help of soap, or soda and soap.

The concentration of the soap and soda solutions, the duration of the milling, and the temperature, depend entirely upon the quality of the material and the desired condition of the cloth. After milling, the cloth is well washed in the washing machine with clean water, to which a little ammonia or soda has been added and then dried. It is urgently recommended that the cloth should not be hung over racks in the unwashed state either after scouring or milling, or else the soap-lye, etc., will run to the edges and become concentrated there, and be apt to cause disturbances in dyeing, but the cloth should in all cases be piled up.

The washing should be done as quickly as possible after milling, as the soap solution might dry up and so become difficult to wash out.

The soap used for milling should be as neutral as possible, but still should not contain any unsaponified fat which would stain the cloth and cause spots. As a rule soda soap is used, but frequently also soft or potash soap.

When dyed wool is milled with soap the colours must answer the following requirements: —

1) The dyeings must not lose too much in intensity.
2) The shade must not be perceptibly altered.
3) The colour must not run into interwoven white, or on to yarns dyed with other colours, i. e. it must not bleed.

These requirements are answered by the Alizarine Colours to a greater or lesser extent, depending upon their chemical nature. The first is satisfied by all Alizarine Colours, but as regards the second a number of Alizarine Colours undergo a slight change towards green, but only with a severe and very alkaline milling. These are: —

Anthracene Blue
Alizarine Blue
Alizarine Indigo Blue
Alizarine Green
Alizarine Black (in light and medium shades).

In dyeing to shade it is desirable to take notice of this circumstance, and to make the shade somewhat redder than required.

The other Alizarine Colours withstand even a strong milling without any noticeable alteration of shade.

The third condition is satisfied both in light and dark shades by the following brands: —

Anthracene Blue (reddish brands)
Alizarine Blue
Alizarine Green
Alizarine Black
Galloflavine
Coeruleïne
Galleïne
Fast Mordant Yellow G.

The following are perfectly fast to milling in medium and dark shades: —

Alizarine Red
Alizarine Orange
Alizarine Maroon
Anthracene Brown
Anthracene Blue (greenish shades)
Mordant Yellow G and R,

whereas in dark full shades they may run into interwoven white if unsuitably treated in milling and washing, but this inconvenience can easily be remedied by after-chroming.

The precautions recommended for the milling of undyed cloth, hold good to a still greater extent for milling dyed goods. It is especially important that the goods be thoroughly washed as soon as possible after mordanting, and that a good neutral soap be used for milling, also the cloth should not be dried at too high a temperature.

Acid milling.

This has already been practiced for a long time in the hat industry, for producing wool- and hair-felt, as it furnishes a very strong and close felt. Whether this method has any advantage over soap milling for the cloth industry and to what extent, is still a matter of lively discussion between the trade papers.

Dyed material which has to be subjected to acid milling requires to have been dyed with colours that are fast to acid, and the arrangement of the Alizarine Colours regarding fastness to acid will be found in the chapter on carbonisation.

Both dyed and undyed cloth must be thoroughly washed before milling, to free it from spinning oil, dressing and impurities, which would otherwise be precipitated in an insoluble form on and within the cloth which leads to the formation of spots and rubbing-off, etc.

The acid milling is done in most cases with dilute sulphuric acid, but still other acids can be used such as acetic acid. After milling, the acid must be removed by washing with clean water.

6. Fastness to acids (carbonisation, etc.).

The fastness of Alizarine dyeings to acids is of especial importance for the carbonisation of wool, the object of which is to remove vegetable impurities contained in the wool such as straw, burrs, etc., by rendering them brittle so that they are easily removed by a suitable treatment. The wool is carbonized partly in the undyed state as loose wool and piece-goods, and partly in the dyed condition as piece-goods.

The vegetable matters are charred by sulphuric acid, but in case the wool is dyed with colours which are sensitive to acids, chloride of aluminium or chloride of magnesium is used; in many cases shoddy is carbonized by gaseous hydrochloric acid.

In order to obtain a good result of the carbonizing operation, it is necessary that the wool and pieces be thoroughly cleansed. If the material contains impurities such as fat, etc., they become fixed by the burning action of the sulphuric acid and are then very difficult to remove, and are therefore apt to cause spots in dyeing.

Sulphuric acid is used for carbonizing undyed wool or wool dyed with Alizarine Colours that are fast to acids. The wool is soaked in dilute sulphuric acid generally 6° Tw. and the excess removed in the hydro-extractor; the goods are then dried in a drying room at a temperature of 175—195° F. Here the acid becomes gradually concentrated and acts on the vegetable fibres in the above-described manner.

After drying most of the sulphuric acid is removed by a good washing, and the rest is neutralized by working in a weak soda solution, then the goods are thoroughly washed. For dyed goods the soda solution should only be strong enough to neutralize the sulphuric acid present.

By using more dilute solution of sulphuric acid 3° to 4½° Tw. and drying at a somewhat lower temperature, one can carbonize dyeings done with colours which are not fast to acid.

However, for the latter chloride of alumina or magnesium is mostly used, as they act less vigorously than sulphuric acid upon the colours. The goods are worked in a solution of chloride of aluminium or magnesium from 7° to 10° Tw., and then dried at 230—250° F.

In this case, the charring effect is brought about by hydrochloric acid which is liberated from the chloride of aluminium or magnesium during the drying operation, whilst basic salts of alumina or magnesia remain on the fibre.

After carbonisation, the goods are rinsed in clean water and then well washed with fuller's earth, which removes the above-mentioned salts. Soda must not be used for neutralizing the acid in this case, as it would cause a separation of alumina or magnesia respectively.

A process of carbonizing with gaseous hydrochloric acid is frequently used for shoddy, to remove cotton and linen particles.

Topping in an acid bath.

The fastness of colours to acids has also to be considered in the case of cloth woven with dyed and white yarn, if the latter is to be dyed with acid-dyeing Aniline Colours.

Most of the Alizarine Colours are fast enough to be used for this special kind of work.

The following are very fast even to strong acids: —

Alizarine Black
Alizarine Blue
Alizarine Indigo Blue
Alizarine Green
Alizarine Orange (alumina and chrome mordant)
Galloflavine
Carbazole Yellow W.

The following are not quite so fast: —

Alizarine Red (alumina and chrome mordant)
Alizarine Maroon (alumina and chrome mordant)
Anthracene Brown
Anthracene Blue
Galleïne
Coeruleïne
Mordant Yellow.

7. *Fastness to chlorine.*

Dyeings produced with Alizarine Colours on wool are very seldom subjected to a chloring operation, therefore a closer consideration of this point is not necessary.

8. *Fastness to stoving.*

Alizarine dyeings on wool are frequently stoved, in order to get the interwoven white as clear and pure as possible. Most of the Alizarine Colours on wool are very fast to stoving, except the following which are not so fast: —

Anthracene Brown
Galleïne
Galloflavine
Alizarine Black
Mordant Yellow.

9. Fastness to the shrinking and finishing process.

"Potting" process.

The object of shrinking and finishing dyed cloth is to impart to it gloss and softness; the operations depend entirely upon the quality of the cloth, and the use that is to be made of it. The mechanical finishing processes i. e. shearing, raising, pressing, etc., have generally a very small or no influence upon the Alizarine Colours, but the shrinking process treatment with steam (varying in tension according to the desired effect), has a similar though much more moderate effect to that of soap milling. All precautions therefore recommended under that heading regarding alteration of shade, must be observed in shrinking.

In many cases the cloths are subjected to a second finishing process called the

"Potting" process,

which imparts to them a high degree of gloss and softness. The dyed or undyed cloths are placed in boiling water in which they are allowed to cool, and the process is repeated several times according to the degree of the desired finish. The Alizarine Colours with a few exceptions resist this treatment very well, and their fastness in this respect can be estimated by noticing the fastness to soap milling.

10. Fastness to ironing.

The effect of hot damp ironing is very similar to that of shrinking, and the statements made under this heading hold good also for ironing.

11. Fastness to perspiration.

With very few exceptions the Alizarine Colours are extremely fast to perspiration.

Application of the Alizarine Colours in the Woollen Industry.

THE first experiments which led to the introduction of the Alizarine Colours into the woollen industry, were made in 1878 with Alizarine Red as a substitute for madder. In the course of years their number has continually increased, their methods of application have been improved, and progress made in their manufacture has rendered them much cheaper, so that at the present time they occupy a prominent place in dyeing wool fast colours.

The Badische Anilin- & Soda-Fabrik has a right to claim the merit of preparing the way for the introduction of the Alizarine Colours into wool-dyeing, and of having, regardless of great trouble and expense, made the Alizarine Colours the public property of dyers.

At the present time the Alizarine Colours are used in all the various branches of the woollen industry for producing fast colours, and their most extensive application is in the manufacture of cloths for wearing apparel.

After the Alizarine Colours had already been extensively used by cloth manufacturers for dyeing various kinds of cloth, and after their excellent qualities had been tried and proved for many years in practical use, the Badische Anilin- & Soda-Fabrik undertook the task of opening up a new field for them.

While the private consumer choses the sorts of cloth and colours accordingly as they appear suitable to his own taste, a considerable quantity of cloth is purchased every year by authorities for army, navy, railway and custom-house officials, for the police, and the fire brigades, etc., which must be dyed accurately to standard shades, and according to strict regulations relating to the dyeing processes.

Up to the introduction of the Alizarine Colours the natural dyestuffs such as indigo, logwood, madder, etc., were prescribed in most cases, but at last the Badische Anilin- & Soda-Fabrik have succeeded by strenuous efforts in obtaining admittance for the Alizarine Colours for dyeing the so-called regulation cloths, in opposition to the natural products which had so far met with no opposition.

The object in view was at last attained as the result of exhaustive wearing experiments; and a great many authorities permitted the use of the Alizarine Colours, whilst others prescribed their exclusive use.

In order to give some idea of the results so far obtained, a list of these authorities will prove interesting; testimonials have been received from all of them which speak in the most favourable terms possible of the Alizarine Colours.

Royal Prussian Ministry of War, Berlin.
Royal Bavarian Ministry of War, Munich.
Royal Wurtemberg Military Constabulary Corps, Stuttgart.
Imperial Ottoman Cloth Works, Fez-Hané.
War-office of the Mexican Republic, Mexico.
Royal Prussian Ministry of Public Works, Berlin
    (for all Royal Prussian Railway Directorates).
Royal Prussian Ministry of Finance, Berlin
    (for all Royal Prussian Customs Officials and Tax-Commissioners).
Imperial Post Office, Berlin
    (for the Imperial postal and telegraph departments).
Imperial German Marine Office.
Royal Belgian Ministry of Justice, Brussels
    (for the prisons and benevolent institutions).
Royal Prussian Presidency of Police, Berlin
    (Fire Brigade Department).
Royal Prussian Presidency of Police, Hanover.
Royal Prussian Presidency of Police, Frankfort °/M.
Royal Prussian Railway Directorate, Breslau.
Royal Prussian Railway Directorate, Elberfeld.
Royal Prussian Railway Directorate, Hanover.
Royal Prussian Railway Directorate, Cologne.
Royal Prussian Railway Directorate, Magdeburg.
Directorate of the Palatinate Railways, Ludwigshafen °/Rhine.
Grand Ducal State Railways of Baden, Karlsruhe.
Grand Ducal Directorate of the Upper Hessian Railways, Giessen.
Royal Equipment Department of the Wurtemberg State Railways, Stuttgart.
Grand Ducal Directorate of the Mecklenburgh Friedrich Franz Railway, Schwerin.
General Directorate of the Royal Imperial Austrian State Railways, Vienna.
Great Berlin Tramway Co. Ld., Berlin.
General Local Railway and Tramway Co., Dortmund District, Dortmund.
Frankfort Tramway Co., Frankfort °/M.
Königsberg Tramway Co., Königsberg.
Magdeburg Tramway Co., Magdeburg.
Stuttgart Tramways, Stuttgart
    etc.

Alizarine Colours are also used to dye cloths for the uniforms of the armies of the following countries: —

Austria, Russia, Belgium, Sweden and Norway, Denmark, Switzerland, Roumania, Servia, Japan, and other states.

A great many authorities have still at the present time the question of the introduction of the Alizarine Colours under consideration, but experience so far leaves no doubt that the Alizarine Colours will also in these instances take the place due to them.

Summary of Mistakes frequently made in the Application of Alizarine Colours on Wool.

THE correct fixation of the Alizarine Colours has the greatest influence upon the quality of the dyeings, which can only answer all requirements when all the approved directions are carried out. In order to make it easier for the dyer to clear up failures, the mistakes frequently occurring in dyeing wool with Alizarine Colours, as well as their consequences are given below.

1) Insufficient cleansing and scouring of loose wool, deficient washing, too hard water (formation of lime soap).

   Consequence: Rubbing-off, inferior fastness of colours to milling.

2) Incomplete removal of spinning oil, etc. from the yarn, partly due to deficient washing, and partly to the use of mineral oils that cannot be saponified.

   Consequence: Rubbing-off, uneven shades, inferior fastness of the colour to milling.

3) Insufficient washing of the cloth after milling.

   Consequence: Rubbing-off, uneven, cloudy, streaky dyeings, etc.

4) Unsuitable treatment of piece-goods after milling, hanging over racks, leaving for some time in an unwashed condition.

   Consequence: Uneven dyeings, dark edges, bleeding of some Alizarine Colours into interwoven white.

5) Drying of milled and washed goods at too high a temperature.

   Consequence: Bleeding of some Alizarine Colours into interwoven white.

6) Carbonizing of badly cleansed wool (loose wool and piece-goods), the fat, etc. as it were, being burnt fast.

   Consequence: Uneven, cloudy, streaky, and specky dyeings which rub off.

7) Unsuitable treatment of carbonized piece-goods after the acid has been washed out and neutralized with soda, such as hanging over racks.

   Consequence: Dark edges, streaky, unlevel dyeings.

8) Dissolving the mordanting materials viz. bichromate of potash, tartar, etc. together in hot water.

   Consequence: Part of the mordant is rendered useless, hence inadequate mordanting and dyeing.

9) Temperature of the mordanting bath being too high at the beginning, or being heated up too rapidly (alumina and chrome mordant).

Consequence: Uneven mordanting and dyeing; goods not dyed through.

10) Too slow and short boiling of the mordanting bath.

Consequence: Insufficient mordanting and dyeing.

11) Insufficient working of the wool in the mordanting bath.

Consequence: Uneven fixation of mordant and therefore also of colour.

12) Defective washing out of the mordanting liquor.

Consequence: Dyeings rub off owing to the colour lake being formed outside the fibre.

13) Wool mordanted with chrome being allowed to lie exposed to light in the unwashed condition.

Consequence: Uneven dyeings owing to the bichromate of potash in the mordanting liquor being reduced by the light.

14) Unsuitable treatment of mordanted yarn and cloth before washing, such as allowing it to hang on rods or racks.

Consequence: Uneven dyeings, dark edges owing to concentration of the mordanting liquor at the edges, etc.

15) Unsuitable storing of the Alizarine Colours.

Consequence: Drying up of paste colours, or absorption of moisture by the powder brands, making the result of the dyeings uncertain.

16) Insufficient stirring of the Alizarine paste colours, drawing off at the bung.

Consequence: Unreliable dyeing due to incorrect concentration of the dyestuff.

17) Incomplete solution of the Alizarine dyestuffs, adding them direct to the dye-bath, or adding the solutions to the dye-bath without using a sieve.

Consequence: Insufficient distribution of the dyestuff in the dye-bath and owing to that unlevel dyeings.

18) Dye-bath being too hot at the beginning, or being too rapidly heated up.

Consequence: Too quick and therefore uneven absorption of the dyestuff; the goods are not dyed through.

19) Insufficient addition of acetic acid to the dye-bath.

Consequence: Incorrect and incomplete fixation of the dyestuffs.

20) The dye-bath boiling too slowly and not long enough.

Consequence: Deficient fixation of the dyestuffs.

21) Insufficient moving of the wool, etc. in the dye-bath.

Consequence: Uneven dyeings.

22) Insufficient rinsing of the wool after dyeing.

Consequence: Rubbing-off.

Directions

for

Dyeing and Printing Alizarine Colours on Wool.

No. 13. (No. 365.)

Directions for dyeing

Alizarine Colours on wool

(loose wool, slubbing, yarn, and piece-goods)

on alumina mordant.

For 100 lbs. wool, etc.

Mordant.

For medium and dark shades the well-scoured wool (loose wool, slubbing, yarn or cloth) is boiled for $1^1/_2$ hours with: —

10 lbs.	alum
3 »	tartar
2 »	oxalic acid,

and for light shades with

5 lbs.	alum
$1^1/_2$ »	tartar
1 lb.	oxalic acid

and then thoroughly rinsed.

Dyeing.

1. Alizarine Red WB, WR, WG and WGG paste
» » SWB, SWR and SWG powder
Alizarine Orange W paste, SW powder and
Alizarine Maroon W paste and W powder.

The dyestuff is well and evenly stirred (the paste colours with about 10 times their weight of cold water, the powder colours with hot water) and added through a fine sieve to the dye-bath. Now add further for

every 1 lb. colour in paste
or $^1/_4$ » » » powder
$^1/_5$ » acetate of lime solid, dissolved in hot water
$^1/_{10}$ » soap (soda or Marseilles soap), dissolved in hot water
$^1/_{20}$ » tannin.

The goods are entered at a temperature of about 86° F., worked for $^1/_4$ hour cold, and then raised slowly within $^3/_4$ hour to the boil which is maintained for $1^1/_2$ hours, and then finally rinsed well.

2. Alizarine Red S, SF, SS, and SSS powder.

The dyestuff is well stirred in hot water and added through a fine sieve to the dye-bath; then add —

for every 1 lb. dyestuff
$^1/_2$ » acetate of lime solid,
dissolved in hot water
$^1/_4$ » soap (soda soap, Marseilles soap),
dissolved in hot water
$^1/_8$ » tannin.

The goods are entered at about 86° F., and worked for $^1/_4$ hour in the cold and then slowly raised within $^3/_4$ hour to the boil.

After boiling for 1 hour add 3 parts of acetic acid 9° Tw. (30 $^0/_0$) for every 1000 parts of dye-liquor, boil for another $^1/_2$ hour and finally well rinse the wool.

3. Anthracene Blue WR, WB, WG, WGG, and WG extra paste.

The dyestuff is stirred with about 10 times its weight of cold water and added through a fine sieve to the dye-bath. The wool is then entered at about 86° F., worked for $^1/_4$ hour cold, then slowly heated during $^3/_4$ hour to the boil and the boiling continued for $1^1/_2$ hours. Finally the wool is well rinsed.

In dyeing very bright shades the mordanting and dyeing should take place in tinned copper boilers or wooden vats. Water containing iron must also be avoided, as copper and iron tarnish the red very much.

No soap is added to the dye-bath when dyeing slubbing, yarn, or piece-goods.

No. 14. (No. 327, 328, 329.)

Directions for dyeing

Wool with Alizarine Colours on chrome mordant

(loose wool, slubbing, yarn and piece-goods).

For 100 lbs. wool, etc.

Mordant.

The well-scoured wool (loose wool, slubbing, yarn, or piece-goods) is mordanted by boiling it for 1½ hours with bichromate of potash and tartar or other additions.

For light shades use: —

1 lb. bichromate of potash
1 » tartar

or medium shades: —

3 lbs. bichromate of potash
2½ » tartar

or

3 » bichromate of potash
1 lb. sulphuric acid 168° Tw.

or

3 lbs. bichromate of potash
1½ » oxalic acid

or

3 » bichromate of potash
2½ » lactic acid (50%)

4 » bichromate of potash
3 » tartar

or

4 » bichromate of potash
1½ » sulphuric acid 168° Tw.

or

4 » bichromate of potash
2 » oxalic acid

or

4 » bichromate of potash
3 » lactic acid (50%).

Each of the mordanting materials must be separately dissolved in hot water and then added to the mordanting bath.

After mordanting the goods are well rinsed.

For 20% Alizarine Red, 15% Anthracene Blue, 1% Mordant Yellow or more, the strong chrome mordant should always be used.

Dyeing.

To the dye-bath (which should have an initial temperature of about 86° F.) add

1—1½ parts acetic acid 9° Tw. (30%)

for soft water (up to 5° hardness);

2—2½ parts acetic acid 9° Tw. (30%)

for water of medium hardness (up to 10° hardness);

3 parts acetic acid 9° Tw. (30%)

for hard water (up to 15° hardness), for every 1000 parts of liquid in the bath.

When using still harder water the quantity of acetic acid must be correspondingly increased, until blue litmus paper is distinctly reddened by it. A sufficient quantity of acetic acid is of great importance, especially for Anthracene Blue.

In many cases, for instance when using Alizarine Colours which are quickly absorbed by the fibre, such as Alizarine Green, Galloflavine, Mordant Yellow, etc., and also for light fancy shades and for material which is difficult to dye level, it is advisable not to add the acetic acid till the bath has been boiling for ½ hour, and then to add it gradually and diluted with water.

The dyestuff stirred with about 10 times its weight of water is added through a fine sieve to the dye-bath, and then the goods are entered. After working for ¼ hour cold, the bath is slowly heated up within 1 hour to boiling and boiled according to the depth of shade for 1½ to 2½ hours. Anthracene Blue especially requires sufficiently long and sharp boiling, or else it will not be correctly developed and the shade remains too red. Finally the goods are well rinsed.

Dyeings with

Alizarine Red
Mordant Yellow G and R
Anthracene Blue (greenish shades)

on loose wool and yarn which are generally subjected to a more or less severe milling process, are after-chromed if they contain a large percentage of dye.

For this purpose

¼% to 1% bichromate of potash

is added at the end of the dyeing operation and the boiling continued for another ½ hour.

Loose wool can be mordanted and dyed in copper boilers, which should only be well washed out and not polished bright.

Yarn and piece-goods are dyed in wooden vats, but slubbing is generally dyed in dyeing machines of various construction.

The following brands are suitable for dyeing chrome-mordanted wool:—

Alizarine Red paste
Alizarine Red S
Alizarine Orange
Alizarine Maroon
Alizarine Blue
Alizarine Indigo Blue
Alizarine Green

Anthracene Blue
Anthracene Brown
Galleïne
Coeruleïne
Galloflavine
Alizarine Black
(the brands marked with W)
Wool Yellow
Mordant Yellow
Fast Mordant Yellow G
Carbazole Yellow W.

No. 15. (No. $328^1/_2$, $329^1/_2$.)

Directions

for

through- and even-dyeing of Alizarine Colours on wool

(yarn and piece-goods)

using chrome mordant.

For 100 lbs. yarn, etc.

Mordant.

The yarn and piece-goods after having been thoroughly scoured are mordanted by boiling for $1^1/_2$ hours in a solution of potash and tartar or another addition.

For light shades which require special attention use

1 lb. bichromate of potash
1 » tartar

for medium shades: —

3 lbs. bichromate of potash
$2^1/_2$ » tartar

or

3 » bichromate of potash
$1^1/_2$ » oxalic acid

or

3 » bichromate of potash
$2^1/_2$ » lactic acid (50 %)

for dark shades: —

4 lbs. bichromate of potash
3 » tartar

or

4 » bichromate of potash
2 » oxalic acid

or

4 » bichromate of potash
3 » lactic acid (50 %).

The mordanting materials must be separately dissolved in hot water and then added to the mordanting bath.

After mordanting the goods are well rinsed.

For 20 % Alizarine Red, 15 % Anthracene Blue, 1 % Mordant Yellow the strong chrome mordant must always be used.

Dyeing.

To the dye-bath, which should have an initial temperature of 86° F., add 3 parts acetate of ammonia B. A. S. F. for every 1000 parts liquid, then the dyestuff is stirred with 10 times its weight of cold water, and added through a fine sieve. The yarn or cloth is now entered and well worked for about $^1/_4$ hour in the cold, then slowly warmed up during $^3/_4$ hour to the boil, and the boiling continued for $^1/_2$ to 1 hour according to the quantity of dyestuff used, and the quality of the goods.

3 parts acetic acid 9° Tw. (30 %)

diluted with water are now added for every 1000 parts liquid in three portions at intervals of 1/4 hour; the goods being lifted out before each addition, and worked briskly on re-entering the dye-bath. When dyeing piece-goods, the acetic acid is poured slowly into the compartment between the rear of the vat and the perforated partition.

In both cases the steam is shut when adding the acetic acid. Anthracene Blue in particular, requires a sufficient quantity of acetic acid. One to two hours boiling (according to depth of shade) is enough for fixing the colours. Anthracene Blue especially requires a sufficiently long and brisk boiling, or it will not be correctly developed and the shade will remain too red.

Dyeings done with a fairly high percentage of

Alizarine Red
Mordant Yellow G and R
Anthracene Blue (greenish shades)

on yarn, which are generally subjected to a more or less severe milling process are after-chromed. For this purpose

1/4 % to 1 % bichromate of potash

is added at the end of the dyeing operation, and the boiling continued for another 1/2 hour.

For shading the steam is shut off and the bath cooled down to 140—158° F. by running cold water in. The acetic acid is neutralized by adding ammonia, but excess of the same must be avoided, only so much being added as to turn red litmus paper slightly blue. Generally

1 to 1 1/2 parts ammonia 20 %

will be required for every 1000 parts of dye-liquor. The dyestuff is now added and the bath heated up to boiling, then

2 parts acetic acid 9° Tw. (30 %)

for every 1000 parts water are added, taking notice of the above-mentioned precautions. The subsequently added dyestuff is fixed by boiling 1/2 to 1 hour and the goods are finally washed well.

Dyeing with acetate of ammonia ought to be done in wooden vats, copper vessels should be avoided.

No. 16. (No. 378.)

Directions for dyeing

Alizarine Colours on soft and stiffened hat-felt

(wool and fur-felt).

For 100 lbs. material.

Hat-felt can be dyed in the soft or stiffened condition, and in the latter case the dyeing and mordanting operations should be begun at a temperature of 158° F. Before dyeing, the wool or fur felt is boiled for 1 hour in clean water to remove impurities.

I. Chrome mordant.

Dissolve separately in hot water and add to the cold mordanting bath: —

3 lbs. bichromate of potash
$2^1/_2$ » tartar

and for dark shades: —

4 lbs. bichromate of potash
3 » tartar.

Boil the felt in this for $1^1/_2$ hours while stirring, and then rinse well.

For 20% Alizarine Red, 15% Anthracene Blue, and 1% Mordant Yellow or darker shades, the strong chrome mordant must always be used.

Add to the dye-bath which should at first have a temperature of 86° F.

3 parts acetate of ammonia B. A. S. F.

for every 1000 parts of water, as well as the dye-stuff which is stirred with about 10 times its weight of cold water and added through a fine sieve. The goods are now entered and worked for $^1/_4$ hour cold, then slowly heated within about $^3/_4$ hour to the boil which is maintained for about $^1/_2$ hour.

3 parts acetic acid 9° Tw. (30%)

for every 1000 parts liquid are now diluted with water, added gradually in 5 portions to the bath, and the boiling continued 2 hours to fix the dyestuff. A sufficient addition of acetic acid is of special importance for Anthracene Blue.

In shading, shut off steam and cool the bath down to about 140—158° F. with cold water and neutralize the acetic acid by adding ammonia, excess of which must however be carefully avoided; only enough being added to cause red litmus paper to be turned faintly blue.

Generally about

$1-1^1/_2$ parts ammonia 20%

will be required for every 1000 parts of liquid.

The dyestuff is now added and the bath slowly raised to the boil, and

2 parts acetic acid 9° Tw. (30%)

then added with the above-mentioned precautions for every 1000 parts of liquid.

The subsequently added dyestuff is fixed by boiling $^1/_2$ hour.

Anthracene Blue especially requires a sufficiently long and brisk boiling, or it will not be correctly developed and the shade will remain too red.

II. Alumina mordant.

Felt hats are dyed with Alizarine Colours on alumina mordant according to process No. 13 under the same conditions given for yarn and piece-goods.

III. One-dip process (Black).

This process is particularly suited for

Alizarine Black

which can be shaded with: —

Anthracene Blue
Alizarine Red
Coeruleïne
Mordant Yellow.

The dyestuff is stirred with about 10 times its weight of cold water, and added to the bath which is then raised to the boil. The goods are now entered, and after 1/4 hours boiling

1 to 3 parts acetic acid 9° Tw. (30 %)

according to the hardness of the water are added for every 1000 parts of liquid in the bath, and the boiling continued for 1/2 hour.

After this,

3 lbs. bichromate of potash

dissolved in about 20 times its weight of hot water are added, and the dyestuff fixed by further boiling 3/4 hour. Finally the goods are well rinsed.

Felt hats are best mordanted and dyed in wooden vats, but copper boilers can also be used.

No. 17. (No. 419.)

Directions for dyeing

Alizarine Colours on wool

(loose wool, slubbing, yarn, and piece-goods)

in one bath.

(Subsequent treatment with bichromate of potash.)

For 100 lbs. wool, etc.

The well-scoured wool (loose wool, slubbing, yarn, or piece-goods) is placed in the unmordanted state in the dye-bath which should not be warmer than 86° F. First of all

1—3 parts acetic acid 9° Tw. (30 %)

are added for every 1000 parts of water (the exact amount depending on the hardness of the water), and then the dyestuff is stirred with about 10 times its quantity of cold water and added through a fine sieve.

The wool is now entered, and the bath heated during 1/2 hour to the boil which is maintained for 1 hour. Then add gradually

1 1/2 lbs. bichromate of potash

dissolved in about 30 times its weight of water. In the case of loose wool, the bichromate is sprinkled over it while it is being worked about, but with slubbing, yarn, and piece-goods the steam is shut off and the bath cooled down to about 176° F. by running in cold water, and the bichromate then added. Finally boil for one hour and then rinse well.

The following Alizarine Colours can be dyed according to these directions: —

Alizarine Black
Alizarine Red paste and powder
Alizarine Orange
Mordant Yellow
Carbazole Yellow W.

The other Alizarine Colours should be added to the bath at the end of the dyeing operation, i. e. after the bichromate of potash has been added, and then fixed by boiling 1/2—1 hour according to their quantity.

No. 18. (No. 389, 406.)

Directions for dyeing

Light shades on wool with Alizarine Colours.

One-bath process.

(Yarn and piece-goods.)

For 100 lbs. yarn, etc.

This process is only adapted for dyeing light shades on yarn or piece-goods which require a small amount of dye (up to say 5% paste colour).

The dye-bath which should have a temperature of about 86° F. is prepared with: —

3 lbs. alum (free from iron) } for alumina

or

3 lbs. acetate of chrome 32° Tw. B. A. S. F.
$1^1/_2$ » oxalic acid

1 lb. fluoride of chrome
1 » oxalic acid

for chrome mordant

and the dyestuff stirred with 10 times its quantity of cold water is added through a fine sieve. The goods are now entered and worked for $^1/_4$ hour cold, and then heated slowly during 1 hour to the boil which is maintained for 1 hour; finally rinse the goods well.

No. 19. (No. 432.)

Directions for dyeing

Anthracene Blue SWX and SWX extra powder on woollen piece-goods

in one bath.

For 100 lbs. stuff.

Anthracene Blue SWX and *SWX extra powder* are only suitable for dyeing piece-goods in one bath.

The bath is prepared at a temperature of about 86° F. with

20 lbs. Glauber's salt (or 1 part acetate of ammonia B. A. S. F.
for every 1000 parts of liquor in the bath)
4 lbs. oxalic acid

and the dyestuff, dissolved in about 10 times its quantity of hot water, added through a fine sieve. (When using hard water of more than 10° hardness the amount of oxalic acid required for neutralizing the lime must be proportionately increased.) The goods are now entered and worked for about ¼ hour cold, then slowly raised during ¾ hour to the boil and the boiling continued for 1 hour.

In dyeing medium shades, the steam is shut off and

3 lbs. fluoride of chrome,

dissolved in hot water, poured gradually into the compartment between the back wall of the vat and the perforated partition, and the vat is again boiled for ½ to 1 hour the object being to fix the dyestuff. Finally the goods are well rinsed in water.

In dyeing closely-woven and severely milled goods, only half of the oxalic acid and dyestuff are added at the commencement of the operation, the remainder being gradually added after the bath has been raised to the boil.

By increasing the addition of oxalic acid, or by adding ½ to 1 lb. oxalic acid together with the fluoride of chrome, more reddish shades are obtained, and the shades are rendered more greenish by a longer boiling with fluoride of chrome.

The following Alizarine Colours are suitable for shading in the same bath: —

Alizarine Black WR
Anthracene Blue WG, WG extra, WGG
Alizarine Red S
Alizarine Orange W
Mordant Yellow G and R.

No. 20. (No. 377.)

Directions for dyeing

Wool with Alizarine Colours in powder

(loose wool, slubbing, yarn, and piece-goods).

For 100 lbs. wool, etc.

The Alizarine powder colours require some modification in the dyeing operation depending on their chemical constitution.

I.

Alizarine Red SWB and SWR powder
Alizarine Orange SW powder
Anthracene Brown SW and SWR powder
Alizarine Indigo Blue SW and SMW powder
Alizarine Green SW powder
Anthracene Blue SWG, SWGG, SWG extra, SWB, SWR, SWRR, SWRR extra, and SWN powder
Anthracene Dark Blue SW powder
Galleïne SW powder.

a) **Chrome mordant.**

The mordanting is carried out according to directions No. 14.

The dyestuff is dissolved in about 20 times its weight of hot water, and the solution added through a fine sieve to the dye-bath. The wool is now entered and the bath heated slowly within 1/2 hour to 140° F.; then 1 part acetic acid 9° Tw. (30 %) for every 1 part by weight of dyestuff, is diluted with 5 times its weight of water and gradually added during the space of 1/2 hour to the dye-bath.

By this means the dyestuff is slowly precipitated from the solution and at the same rate fixed on the fibre. The bath is now raised gradually during 1/2 hour to the boil, and 1—3 parts acetic acid 9° Tw. (30 %) (according to the hardness of the water) added, and the boiling continued for 2 hours.

b) **Alumina mordant.**

Only the following dyestuffs are suitable for dyeing on an alumina mordant and are dyed according to process No. 13.

Alizarine Red SWB and SWR powder
Alizarine Orange SW powder
Anthracene Blue SWG, SWGG, SWG extra, SWB, SWR and SWRR powder.

II.

The following dyestuffs are dyed on a chrome mordant according to process No. 14.

Alizarine Red S, SS, and SSS
Alizarine Maroon W powder
Alizarine Black WR powder
Alizarine Blue Black W powder
Galleïne W powder
Galloflavine W powder
Wool Yellow powder
Mordant Yellow G and R
Fast Mordant Yellow G
Carbazole Yellow W.

The brands

Alizarine Red S, SS, and SSS powder
Alizarine Maroon W powder

can also be dyed according to process No. 13 on alumina mordant. They must be dissolved in hot water before being added to the dye-bath.

III.

The following colours are dyed on a chrome mordant according to process No. 14, they must be dissolved in cold water: —

Alizarine Blue SW and SRW powder
Alizarine Dark Blue SW powder
Alizarine Black SW and SRW powder
Alizarine Blue Black SW powder
Coeruleïne SW powder.

No. 21. (No. 1005.)

Directions for dyeing

Alizarine Colours on slubbing in dyeing machines.

Chrome and alumina mordant.

For 100 lbs. slubbing.

Alizarine Colours can be dyed on slubbing in the various dyeing machines according to the general directions for wool dyeing, but some slight modifications are necessary.

The water should be as free as possible from lime, and it is best to use purified water.

The soluble powder and paste brands are especially suitable but the other Alizarine paste brands can also be used, partly under addition of alkaline solvents (soda, ammonia).

a) Chrome mordant.

The process is the same as that given in No. 14, except that the acetic acid is not added until the bath has been boiling for 1/2 hour, and nearly all the dyestuff has been absorbed by the fibre.

A slight alteration is required in working with the bisulphite combinations of Alizarine Blue, Alizarine Indigo Blue, Alizarine Green and Coeruleïne, in that the dye-bath must be kept at a temperature of 140° F. until it appears to be exhausted, then the acetic acid is added and the dye-bath raised to the boil.

b) Alumina mordant.

The dyeing is carried out according to process No. 13, except that the acetate of lime and tannin are not added until the bath has been raised to the boil; beyond that the process is exactly the same as the one referred to.

No. 22. (No. 433.)

Directions for dyeing

Alizarine Colours on slubbing in one bath

(with a mordant of bichromate of potash-lactic acid-sulphuric acid).

For 100 lbs. slubbing.

The slubbing is first thoroughly wetted, and then placed in the machine either open or wound as loosely as possible. The mordant is now added using for medium and dark shades

1½	lbs.	bichromate of potash
3	»	lactic acid 50% (C. H. BOEHRINGER SOHN)
1½	»	sulphuric acid 168° Tw.

and the two first must be separately dissolved in hot water.

It is advisable to use only half the quantity of the mordants given above when dyeing light shades, say 3% dyestuff or less.

The mordanting liquid should have a temperature of 86° F. at the beginning, and is then slowly heated up during ¾ hour to the boil and the boiling continued for ¼ hour, after which time the bath should be completely exhausted.

With hard water the amount of sulphuric acid must be increased accordingly; the required quantity can be judged by the complete exhaustion of the bath.

The bath is now cooled down to about 140° F. by running off a part of the liquor and adding cold water. The dyestuff stirred with about 10 times its quantity of cold water is then added to the bath through a fine sieve, and the bath brought within about ¾ hour to the boil.

After boiling for 1 hour, add gradually 2 parts of acetic acid 9° Tw. (30%) diluted with water for every 1000 parts of liquid and boil further for 1 hour. One part of acetic acid is enough for 1000 parts of liquid when dyeing very light shades, but the quantity must be correspondingly increased when using hard water.

It is of special importance to add a sufficient quantity of acetic acid when dyeing with Anthracene Blue, and it also requires a sufficiently long and brisk boiling, or the colour will not be correctly developed and will remain too reddish in shade.

In most cases the above-described process must be modified on account of the varying construction of the different dyeing machines, but no directions of general validity can be given in this respect.

No. 23. (No. 1006.)

Directions for dyeing

Alizarine Red S in one bath on alumina mordant

(loose wool, slubbing, yarn, and piece-goods).

For 100 lbs. wool, etc.

The material (loose wool, slubbing, yarn, and piece-goods) must be thoroughly cleansed in the usual manner.

The bath is prepared at a temperature of about 86° F. with:

20 lbs. Glauber's salt
1—2 » oxalic acid

and the dyestuff dissolved in about 10 times its quantity of hot water, is added through a fine sieve to the dye-bath. For very hard water (over 10° hardness) the amount of oxalic acid must be increased accordingly. The unmordanted goods are now entered and worked for $^1/_4$ hour cold, then heated slowly during $^3/_4$ hour to the boil and the boiling continued for 1 hour.

The dyestuff is fixed by slowly adding

10 lbs. alum

dissolved in hot water, and boiling for $^1/_2$—1 hour more. Finally the goods are well rinsed.

The dyeing can be carried out in copper vessels or wooden vats, and where only copper boilers are at hand $^1/_5$ part sulphocyanide of ammonia are added for every 1000 parts water.

No. 24. (No. 408.)

Directions for dyeing

White on loose wool, woollen yarn, and piece-goods

(bleaching with bisulphite and dyeing with Alizarine and Aniline Colours).

For 100 lbs. wool, etc.

For producing a fine clear white specially selected raw wool must be employed, which should be as white as possible and free from yellow tips. The most suitable method is to work with two baths.

Bleaching bath.

This is prepared from

4 gall.	bisulphite of soda 72/77° Tw. B. A. S. F.
0·3 »	sulphuric acid 168° Tw.
500 »	clean cold water free from iron.

The well-scoured and carefully rinsed wool is well worked for 25 to 30 minutes in this bath, then lifted out and the liquid allowed to run off.

Dye-bath.

The dyeing can be done with either the Alizarine or Aniline Colours; of course the white furnished by the latter is not so fast to light and milling, but is purer and brighter.

A. Alizarine Colours.

The dye-bath is prepared according to the desired shade with

$1^1/_2$ to $2^1/_2$ oz.	Alizarine Green SW paste, or Anthracene Blue WR, WG extra, WGG or WG
3 lbs.	alum
2 »	oxalic acid
500 gall.	clean water free from iron, 86° F.

The dyestuff is dissolved by stirring it with cold water, and added through a fine sieve to the dye-bath.

The bleached goods are now entered and worked for about 10 minutes cold and the bath heated within about $^1/_2$ hour to the boil, and boiled for $^1/_4$ hour. Finally, the goods are rinsed well and dried at the ordinary temperature.

B. Aniline Colours.

The bath is prepared according to the shade desired from

$^1/_8$ oz.	Alkaline Violet, Acid Violet 6 BN, etc.
500 gall.	cold clean water free from iron

(that is 1 part dyestuff to 240,000 water).

The dye is dissolved in about 2 gallons hot water and passed through a woollen cloth into the dye-bath, the wool is then entered at a temperature of about 104° F. and worked well for about $^1/_4$ hour at this temperature which causes the dyestuff to be fixed. Finally rinse in clean water and dry at the ordinary temperature.

Remarks.

It is necessary that the water used for dyeing wool white should be clean and free from iron, and if the water does not answer these conditions it must be purified by boiling with bran, skimming, and allowing to cool down.

If several lots are dyed white in quick succession, the baths can be repeatedly used after being replenished for each operation with $^4/_5$ of the original quantities of bisulphite and sulphuric acid.

It is advisable not to let the bleaching bath stand for any length of time, as the bisulphite becomes oxidized to Glauber's salt and at the same time loses its bleaching properties.

No. 25. (No. 379, 424.)

Directions for printing

Alizarine Colours on wool

(woollen cloth, slubbing, and yarn).

Alizarine Colours can be printed on prepared (chlored), as well as unprepared wool. Chloring considerably increases the attraction of the wool fibre for the dyestuff, but at the same time renders it a little less suitable for felting.

Woollen cloth is always printed in the chlored condition, but this preparation is frequently omitted with yarn and slubbing.

When using the following dyestuffs it is advisable to pass the slubbing, etc. through chlorine: —

Alizarine Blue SW paste
Alizarine Indigo Blue SW paste
Alizarine Green SW paste
Coeruleïne SW paste
Anthracene Brown W
on chrome mordant.

The remaining dyestuffs can be printed on chlored quite as well as on unchlored material.

Chloring of the Wool.

Prepare a bath of: —

1 part hydrochloric acid 32° Tw.
100 parts water

in a suitable apparatus. Work the wool in this solution, and add gradually while stirring in small portions at a time: —

$2^{1}/_{2}$ parts of a solution of bleaching powder $1^{1}/_{2}$° Tw.

for every 1 part of wool, or better still

$2^{1}/_{2}$ parts of a solution of hypochloride of soda $1^{1}/_{2}$° Tw.

Work the wool in this bath for 1 hour and then wash and dry.

Thickening.

Starch or British gum thickening is used for woollen cloth or yarn and British gum or dextrine for slubbing.

Starch thickening.

2	parts	wheat starch
5	»	solution of gum tragacanth 60 : 1000
$1^{1}/_{4}$	»	olive oil
20	»	water.

British gum thickening.

6—10 parts British gum

are boiled for 1/4 hour with

6 » water

and then stirred till cold.

Dextrine thickening.

10 parts dextrine

are boiled with

6 » water

for 1/4 hour and then stirred till cold.

Printing Colours.

1. **Alizarine Red paste** (alumina mordant).

10	lbs.	Alizarine Red WB, WR, WG 20%
4	»	sulphate of alumina dissolved in
10	»	water
2	»	oxalic acid dissolved in
5	»	water
5	»	glycerine
5	»	Turkey-red oil D
59	»	British gum thickening
100	lbs.	

2. **Alizarine Red S** (alumina mordant).

3	lbs.	Alizarine Red S dissolved in
10	»	water
4	»	sulphate of alumina dissolved in
10	»	water
2	»	oxalic acid dissolved in
5	»	water
66	»	British gum thickening
100	lbs.	

3. **Alizarine Orange** (alumina mordant).

20	lbs.	Alizarine Orange W 15%
3	»	sulphate of alumina dissolved in
10	»	water
2 1/2	»	oxalic acid dissolved in
7 1/2	»	water
57	»	British gum thickening
100	lbs.	

4. **Alizarine Red paste** (chrome mordant).

20	lbs.	Alizarine Red WB, WR, WG 20%
5	»	acetic acid 9° Tw. (30%)
10	»	acetate of chrome 32° Tw. B. A. S. F.
65	»	British gum thickening
100	lbs.	

5. **Alizarine Red S** (chrome mordant).

3	lbs.	Alizarine Red S dissolved in
10	»	water
$7^{1}/_{2}$	»	acetate of chrome 32° Tw. B. A. S. F.
2	»	oxalic acid dissolved in
5	»	water
$72^{1}/_{2}$	»	British gum thickening
100	lbs.	

6. **Alizarine Orange** (chrome mordant).

20	lbs.	Alizarine Orange W 15%
5	»	acetic acid 9° Tw. (30%)
10	»	acetate of chrome 32° Tw. B. A. S. F.
65	»	British gum thickening
100	lbs.	

7. **Alizarine Maroon.**

20	lbs.	Alizarine Maroon W 20%
$7^{1}/_{2}$	»	acetic acid 9° Tw. (30%)
$12^{1}/_{2}$	»	acetate of chrome 32° Tw. B. A. S. F.
60	»	British gum thickening
100	lbs.	

8. **Alizarine Blue.**

20	lbs.	Alizarine Blue SW paste
4	»	acetate of chrome 32° Tw. B. A. S. F.
76	»	British gum thickening
100	lbs.	

9. **Alizarine Indigo Blue.**

20	lbs.	Alizarine Indigo Blue SW paste
6	»	acetic acid 9° Tw. (30%)
6	»	acetate of chrome 32° Tw. B. A. S. F
5	»	oxalic acid dissolved in
5	»	water
58	»	British gum thickening
100	lbs.	

10. Alizarine Green.

20	lbs.	Alizarine Green SW paste
6	»	acetic acid 9° Tw. (30 %)
6	»	acetate of chrome 32° Tw. B. A. S. F.
5	»	oxalic acid dissolved in
5	»	water
58	»	British gum thickening
100	lbs.	

11. Anthracene Blue.

25	lbs.	Anthracene Blue WR, WB, WG
7½	»	acetic acid 9° Tw. (30 %)
7½	»	acetate of chrome 32° Tw. B. A. S. F.
2	»	oxalic acid dissolved in
3	»	water
55	»	British gum thickening
100	lbs.	

12. Anthracene Brown.

20	lbs.	Anthracene Brown W
15	»	acetate of chrome 32° Tw. B. A. S. F.
1	»	oxalic acid dissolved in
4	»	water
60	»	British gum thickening
100	lbs.	

13. Galleïne.

30	lbs.	Galleïne W
3	»	acetate of chrome 32° Tw. B. A. S. F.
2	»	oxalic acid dissolved in
5	»	water
60	»	British gum thickening
100	lbs.	

14. Coeruleïne.

15	lbs.	Coeruleïne SW paste
15	»	water
6	»	acetate of chrome 32° Tw. B. A. S. F.
3	»	oxalic acid dissolved in
5	»	water
56	»	British gum thickening
100	lbs.	

15. Galloflavine.

10	lbs.	Galloflavine W
5	»	acetic acid 9° Tw. (30 %)
2	»	acetate of chrome 32° Tw. B. A. S. F.
83	»	British gum thickening
100	lbs.	

16. Alizarine Black.

25	lbs.	Alizarine Black SR paste
5	»	acetic acid 9° Tw. (30 %)
10	»	acetate of chrome 32° Tw. B. A. S. F.
3	»	oxalic acid dissolved in
5	»	water
52		British gum thickening
100	lbs.	

17. Mordant Yellow G and R, Fast Mordant Yellow G.

2	lbs.	Mordant Yellow G, R, Fast Mordant Yellow G dissolved in
16	»	water
5	»	acetic acid 9° Tw. (30 %)
10	»	acetate of chrome 32° Tw. B. A. S. F.
2	»	oxalic acid dissolved in
5	»	water
60	»	British gum thickening
100	lbs.	

18. Carbazole Yellow W.

2	lbs.	Carbazole Yellow W heated with
83	»	starch thickening until the dyestuff is dissolved, then stir till cold
5	»	acetate of chrome 32° Tw. B. A. S. F.
5	»	oxalic acid dissolved in
5	»	water
100	lbs.	

After printing, the wool without being dried is steamed for 1 hour at $^{1}/_{4}$ atmosphere pressure and then well washed.

No. 26. (No. 427.)

Directions

for producing a silky gloss and "handle" on Alizarine-dyed woollen yarn.

To produce a silky gloss and "handle" the woollen yarn after having been thoroughly cleansed is treated with chlorine.

The yarn is worked for 20 minutes in a warm solution (75—85° F.) of 20 parts hydrochloric acid 32° Tw. in 1000 parts water. It is now superficially wrung out, or the liquid is allowed to run out, and then worked for 20 minutes in a weak solution of bleaching powder at 75—85° Tw. which contains 15 parts of bleaching powder in 1000 parts water.

A standard solution of bleaching powder of a given strength is made for preparing and replenishing the bath and must be filtered or clarified by decanting before use.

The chlored material is now well washed and mordanted and dyed according to one of the given processes. This chloring considerably increases the affinity of the woollen fibre for both mordant and dyestuff.

After rinsing the dyed wool is well worked for 1/4 hour in a solution of 5 parts soap (solid) in 1000 parts water at a temperature of 75—85° F.

The yarn is now without washing placed in a fresh bath containing 5 parts of sulphuric acid 168° Tw. in 1000 parts of water and worked for 1/4 hour at a temperature of 75—85° F. and then well rinsed and dried.

For light shades of Mordant Yellow and also of Alizarine Red and Alizarine Orange on alumina mordant this acid treatment must be done with 10 parts acetic acid in 1000 part water instead of with sulphuric acid.

The baths with the exception of the dye-bath are used over again after having been adequately replenished.

D.

Unions (Wool and Cotton).

THE manufacture of half-woollen stuffs has recently experienced a considerable increase, since a durable and good-looking material can be produced at a very low price by using the cheap cotton in connection with wool.

Union cloth can be made in two different ways, viz: —

1) By mixing loose wool and cotton, then spinning the mixture into yarn which is woven into cloth.
2) By weaving woollen yarn together with cotton yarn (the latter serving mostly as warp).

Wool and cotton occur in such cloth both in the dyed and undyed condition.

The materials employed in producing union goods can be dyed as follows: —

1. Dyeing the loose wool or woollen yarn and the loose cotton or cotton yarn separately.

These are dyed according to the processes given for cotton and wool and require no further explanation.

2. Dyeing of union yarn or union stuff made of dyed wool and undyed cotton.

In this case it is only a matter of dyeing the cotton, which can be carried out according to the known directions for the Alizarine Colours. However, the oiling operation necessary for dark shades must be omitted, as the wool would absorb oil and therefore mordant, and so dye a darker shade. In this case the Alizarine Colours would be insufficiently fixed on the wool, and would rub off badly.

For light shades which require no oil treatment, the union goods can be mordanted with chloride of chrome or acetate of alumina without the wool taking up any of the mordant. This is, however, assuming that the wool has not been dyed with mordant dyes, as otherwise owing to its great affinity for the Alizarine Colours, it would deprive the cotton of a part of them. On the other hand, the wool must be dyed sufficiently fast to withstand the mordanting and dyeing of the cotton.

3. Dyeing of union yarn or union cloth made of dyed cotton and undyed wool.

In this case where the question is to dye the wool, the Alizarine Colours can be very well fixed on the latter by exactly following the directions given for wool.

It is however essential, that only such dyestuffs be used for the cotton that withstand the action of chrome — or alumina — mordant, and which do not noticeably alter in shade during the dyeing process. The Alizarine Colours as well as a number of Aniline Colours answer this purpose.

In practice, this method is used for union stuffs which contain previously dyed cotton warp; the wool is dyed in various shades of blue, black, brown, etc.

4. Dyeing union stuffs prepared from undyed cotton and undyed wool.

Half-woollen material can be dyed with the Alizarine Colours alone by combining the dyeing processes for wool and cotton.

In this case, however, the cotton will always be somewhat lighter, as the wool absorbs the mordant more easily and completely than cotton, and the Alizarine Colours are taken up more rapidly by wool than by cotton. Besides the process would come in rather expensive for the cheap material. The wool contained in union material, can be first dyed according to the ordinary process for wool dyeing, and the cotton afterwards dyed with aniline or wood colours.

For dark shades such as dark brown, dark blue, black, etc., it is advantageous to dye the cotton with sumac and iron salts, which give very full-bodied colours to the cotton fibre.

Considering the low price of union cloth which makes it necessary to use a simple and cheap dyeing process, the use of the Alizarine Colours in this branch of the textile industry has so far been a very limited one.

It is impossible to give general directions for dyeing unions with Alizarine Colours, as the dyeing process depends upon the required shade, and on the proportion of cotton and wool contained in the goods.

E.

Silk.

ALIZARINE COLOURS are very well adapted for producing fast colours on silk, the most costly of the textile fibres.

The several varieties of silk are divided into two groups, viz. artificially reared and wild silk. The former is worked up into yarn as organzine and tram silk, and the waste, etc. furnishes the so-called floss-silk, spun silk, chappe silk. The chief representative of the wild silk group is called Tussah silk, it is much more difficult to dye than cultivated silk.

These different kinds of raw silk must be boiled-off with soap before dyeing, so as to remove the silk gum (sericine), which would interfere with the dyeing operation. The soap baths so obtained are used as "boiled-off liquor" in the dyeing of silk.

Dyeing of silk.

The boiled-off silk is dyed with Alizarine Colours in a loose condition, as yarn or as cloth, according to methods similar to those used for cotton. It may be dyed in the weighted or unweighted condition, or the weighting can be brought about during the dyeing operation.

Chrome and alumina salts are used as mordants and also in some cases iron salts.

Alumina Mordant.

Alum which has been rendered basic with soda is employed as alumina mordant, which is capable when acting for some time of depositing a basic alumina salt on the fibre, as is the case when using cotton.

The silk is immersed in the mordanting bath and let soak there for 12 hours. It is now well wrung out, squeezed, or hydro-extracted, and without washing placed in a bath of silicate of soda, bicarbonate of potash, etc. which by neutralizing the sulphuric acid contained in the basic alumina salt, fixes alumina on the fibre in an insoluble form. The silk is finally washed, if possible in running water.

The mordanting bath can be used again after adding the necessary quantity of alum and soda each time it is required, but the fixing bath of silicate of soda etc. must be prepared fresh each time.

Chrome Mordant.

For this purpose, chloride of chrome 32° Tw. B. A. S. F. is used, which is capable of giving up a basic chrome salt or chrome oxide to the silk fibre even in the cold. The silk is immersed for 12 hours in this solution, then wrung out and washed, if possible in running water, which causes the chrome to be fixed in an insoluble state on the fibre.

The complete fixation of the chrome is brought about as in the case of alumina, by means of silicate of soda, bicarbonate of soda, etc. which neutralize the acid of the basic chrome salt. Finally the goods are well washed, and where possible in running water.

The chloride of chrome bath is used for further operations, and where necessary brought to its original strength by addition of chloride of chrome 52° Tw.

The fixing bath of silicate, etc. is always prepared afresh.

In both cases the silk is ready for dyeing without being dried, and is best dyed in a soap-bath, for which purpose the boiled-off liquor obtained in boiling off raw silk is generally used. It should, however, not be too old, and also not contain too much gum, and it is best to use that boiled-off liquor which results from the second boiling. Common soap can also be used in place of the latter.

As is the case with cotton, alumina-mordanted silk requires the presence of lime in the dye-bath for producing a fine red with Alizarine Red. For this purpose therefore hard water must be used, and soft water must be hardened by adding an appropriate quantity of acetate of lime.

Alizarine Red on an alumina mordant is dyed in a neutral bath, only so much acetic acid being added that neither blue litmus paper is turned red, nor red litmus paper blue. The bath must be slightly acidified for Alizarine Red on chrome mordant, and for all other Alizarine Colours.

As usual the dyestuff is stirred with about 10 times its quantity of cold water, and added through a fine sieve to the dye-bath, then the acetic acid is added and the silk entered. The goods are first worked cold, the bath is then slowly raised to the boil and the boiling continued for 1 hour. In order to obtain even shades, it is necessary to heat up the bath slowly and move the goods briskly. It is also advisable, to lift the silk out of the bath previous to boiling, and re-enter it when the bath is boiling. After $^1/_4$ hour these operations, etc. are repeated, as in this manner the silk is better preserved.

The silk is now treated in a boiling soap solution, in order to improve the gloss and fastness, and to give it a good "handle", then after being well washed, it is brightened in a warm bath of acetic acid.

After being well wrung out, the goods are dried without washing.

All Alizarine Colours can by fixed on silk according to the above method, but a slight modification is necessary in dyeing a deep black with

Alizarine Black on silk.

The silk is mordanted with chloride of chrome as above described, but the dye-bath must be very concentrated,

100 parts of water being sufficient for
7 » Alizarine Black paste.

In this case, an addition of "boiled-off liquor" and also acetic acid is not needed. The dyeing operation, the soaping and brightening with acetic acid, are carried out in the same way as above described, and the dye-bath is not exhausted, but can be repeatedly used after adding 3 to 4 parts of dyestuff for every 100 parts liquid. The black is shaded by replacing part of the Alizarine Black by other Alizarine Colours, for instance, *Alizarine Blue, Alizarine Indigo Blue,* etc. are used for a bluish black, and *Galloflavine, Coeruleïne, Carbazole Yellow W,* etc. are used for a deep black. This process can also be employed for all kinds of very dark shades, such as dark brown, dark blue, etc. if suitable dyestuffs are applied.

Silk, like wool and cotton, can also be dyed light shades in one bath. The dyestuff is added to the dye-bath along with alum or acetate of chrome, and at the same time oxalic acid is added to prevent the lake being formed too rapidly. This process is, however, not suitable for dyeing medium or dark shades, as the dyestuff, which must be slowly absorbed by the fibre in order to produce even shades, would to a large extent be converted into a lake in the dye-liquor which could no longer be fixed on the silk.

The process long known and frequently applied for dyeing logwood black with an iron mordant on silk, is also well adapted for producing a fast black with

Alizarine Black.

The boiled-off silk is first immersed in a chloride of tin solution, then well wrung out and soaped at the boil. The well-washed silk is now placed in a bath of the so-called nitrate of iron (basic sulphate of iron), and let remain there $^1/_4$ to $^1/_2$ hour, after which it is again well washed and treated in a boiling soap-bath. The silk is now placed in a bath of *yellow prussiate of potash* and *hydrochloric acid,* which gives the silk a blue ground due to the formation of Prussian Blue. After a good washing the silk is worked in a bath of cutch, then washed and dyed without drying.

The treatment with the various mordants, etc. such as chloride of tin, nitrate of iron, prussiate of potash, cutch, and the intermediate soap-baths, are partially intended for weighting purposes, and can be repeated one or several times if the silk requires to be heavily weighted. The treatment with tin and cutch can be dispensed with, where only slight weighting is required. If no bluish black is required, the production of Prussian Blue by using yellow prussiate of potash can also be omitted.

The silk mordanted in the above manner is dyed in a bath to which soap has been added, and which has been acidified by acetic acid, first cold and then boiling. After being well washed, the dyeings are soaped and then brightened with acetic acid.

Printing on silk.

The Alizarine Colours are also adapted for printing silk yarn and cloth, and the printing operations are carried out in a way similar to that for cotton.

The silk is printed in the boiled-off condition and requires no further preparatory treatment, after printing it is dried, and the colour fixed by a steaming process. Finally it is well washed and soaped.

Gum is especially suitable as a thickening agent, but starch can also be used.

All the Alizarine Colours can be printed on silk, but only the *S paste* and *S R paste brands of Alizarine Black* are suitable.

Fastness of Alizarine Colours on Silk.

THE Alizarine Colours on silk are remarkably fast to light, soap, etc. Of course all the dyestuffs of this group are not equally fast, as they differ in chemical constitution; the method of fixation has also a certain influence on the fastness. It is necessary in all cases in testing the fastness, to compare dyeings of equal depth of shade, as light dyeings are never so fast as dark ones.

1. Fastness to light.

Alizarine Red fixed with alumina mordant on silk, is, like Turkey-red, extremely fast to light. The following brands are similar as regards fastness to light: —

Alizarine Red (chrome mordant)
Alizarine Orange
Alizarine Blue
Alizarine Indigo Blue
Alizarine Green
Anthracene Blue (chrome mordant)
Anthracene Brown
Coeruleïne
Alizarine Black (as Black),

whereas the following Alizarine Colours are not so fast: —

Alizarine Maroon
Anthracene Blue (alumina mordant)
Galleïne
Galloflavine W
Mordant Yellow
Carbazole Yellow W.

2. Fastness to water.

The Alizarine Colours are without exception completely fast to water, and lose no dye when placed in hot water, also intertwined white silk is not stained.

3. Fastness to air, weather.

The fastness of the Alizarine Colours on silk to air and weather is on a par with their fastness to light.

4. Fastness to soap.

All Alizarine Colours on silk are very fast to soap, and stand boiling soap baths without being perceptibly affected.

5. Fastness to wear and rubbing.

The Alizarine Colours on silk are very fast to rubbing and, therefore, wear excellently.

6. Fastness to acids.

Some of the Alizarine Colours are extremely fast to acids, whereas others are not so fast. The first group comprises the following brands: —

Alizarine Black
Alizarine Blue
Alizarine Indigo Blue
Alizarine Green
Alizarine Orange
Galloflavine.

The following are not quite so fast: —

Alizarine Red
Alizarine Maroon
Anthracene Brown
Anthracene Blue
Galleïne
Coeruleïne
Mordant Yellow
Carbazole Yellow.

7. Fastness to chlorine.

The fastness of Alizarine Colours to chlorine is of very small importance, as this material is not subjected to a chloring process.

8. Fastness to steaming, shrinking, and finishing.

The fastness of Alizarine Colours to these processes, resembles their behaviour on being treated with soap.

9. Fastness to stoving.

The Alizarine Colours on silk stand stoving without any noticeable alteration in shade.

10. Fastness to ironing.

The effect of ironing is similar to that of steaming (shrinking and finishing).

11. Fastness to perspiration.

All the Alizarine Colours on silk are very fast to perspiration.

12. "Handle" and gloss.

The "handle" of silk is somewhat influenced by the mordant, especially by the chrome mordant; but little influence is noticed as regards gloss.

Directions

for

Dyeing and Printing Alizarine Colours on Silk.

No. 27. (No. 380.)

Directions for dyeing

Alizarine Colours on silk

(loose silk, yarn, and cloth).

Alumina mordant.

The silk must be boiled-off before dyeing, and can be dyed in the weighted or in the unweighted condition.

Mordanting.

60 parts alum (free from iron) are dissolved in
1000 » water

and

6 parts soda crystals

added, and the solution boiled until the precipitate which forms at first has dissolved. The silk is worked for $^1/_4$ hour in this bath, and left standing in it for 12 hours, care being taken that it is perfectly penetrated, and completely immersed in the liquid. It is now wrung, squeezed, or hydro-extracted, and without washing placed in the fixing bath which consists of a solution of

silicate of soda 1° Tw.

Work briskly for $^1/_4$ hour in this solution, then wash well if possible in running water, and wring out and dye without drying.

The mordanting bath can be used again after adding the requisite amount of alum and soda, but the fixing bath must be prepared afresh every time.

Dyeing.

Add to the dye-bath: —

100 parts water
20 » "boiled-off liquor".

The latter must neither be too old, nor contain too much silk gum, and it is therefore best to use the "boiled-off liquor" obtained from the second boiling-off.

The dyestuff is now stirred with about 10 times its weight of cold water, and added through a fine sieve to the dye-bath.

For Alizarine Red the bath is just neutralized with acetic acid 9° Tw. (30 %), that means, that so much acetic acid is added that blue litmus is not turned red, or red litmus blue. Alizarine Red also requires the presence of lime in the dye-bath, and therefore hard calcareous water is used, or soft water is hardened by addition of acetate of lime. In working with the other Alizarine Colours the bath is slightly acidified with acetic acid.

The dye-bath should contain about 30 times as much water as silk, and ought to be free from iron.

The silk is placed in the dye-bath at about 86° F., worked for about 1/4 hour at this temperature, then heated slowly during 3/4 hour to the boil, and the boiling continued for 1 hour. Finally the silk is washed well.

Soaping and brightening.

In order to increase the brilliancy and fastness of the colour, and to obtain a good gloss and "handle", the dyed silk is boiled for 1/4 hour in a bath containing

2 parts soap in
1000 » water

then well washed, wrung and worked for 1/4 hour at 120° F. in a bath of

20—25 parts acetic acid 9° Tw. (30 %) in
1000 » water.

Finally wring out, and dry without washing.

It is not necessary to cool down the bath when shading; the dyestuff dissolved in water can be added to the boiling bath after the silk has been taken out. Suitably constructed wooden vats are the best vessels to use for dyeing silk.

The above process is adapted only for the following brands: —

Alizarine Red paste
Alizarine Orange
Alizarine Maroon
Anthracene Blue
Anthracene Brown
Galleïne
Coeruleïne.

No. 28. (No. 381.)

Directions for dyeing

Alizarine Colours on silk

(loose silk, yarn, and stuff).

Chrome mordant.

The silk is boiled-off before dyeing, and can be dyed either weighted with tin or in the unweighted condition.

Mordanting.

The silk is worked for $^1/_4$ hour in

chloride of chrome 32° Tw. B. A. S. F.

and let soak in it for 12 hours, taking care that it is evenly penetrated and completely immersed in it, then wrung well, washed if possible in running water, and placed in a fixing bath of

silicate of soda 1° Tw.

It is worked for $^1/_4$ hour in this solution, then thoroughly washed if possible in running water, wrung out and dyed without drying.

The chloride of chrome bath can be repeatedly used if it is kept up to its original strength of 32° Tw. by adding

chloride of chrome 52° Tw. B. A. S. F.,

but the fixing bath must be prepared afresh for each operation.

Dyeing.

Add to the dye-bath:

100 parts water
20 » "boiled-off liquor".

The latter must not be too old, or contain too much silk gum, and it is therefore best to use the "boiled-off liquor" obtained by the second boiling. The dyestuff is now stirred with about 10 times its quantity of cold water, added through a fine sieve to the dye-bath, and the latter is made slightly acid by addition of acetic acid 9° Tw. (30%). The dye-liquor should have about 30 times the weight of the silk to be dyed.

The silk is entered at about 85° F. and worked for $^1/_4$ hour at that temperature, then slowly raised during $^3/_4$ hour to the boil, and the boiling continued for 1 hour. Finally the silk is well washed.

Soaping and brightening.

To increase the beauty and fastness of the colour and to obtain gloss and "handle", the dyed silk is boiled for $^1/_4$ hour in a bath of

2 parts soap
1000 » water.

It is now well washed, wrung and worked for $^1/_4$ hour at 120° F. in a bath containing

20—25 parts acetic acid 9° Tw.
1000 » water,

then wrung out and dried without washing.

In shading it is not necessary to cool the bath down, but the silk is lifted out and the dyestuff dissolved in water is added to the boiling bath.

Silk is best dyed in suitably constructed wooden vats.

All the Alizarine Colours can be dyed according to this process, with the exception of Alizarine Yellow A and C, Alizarine Black S paste, SR paste and SRA paste.

No. 29. (No. 390.)

Directions for dyeing

Black with Alizarine Colours on silk

(loose silk, yarn, and stuff)

in a concentrated bath.

Chrome mordant.

The boiled-off silk can be dyed in the weighted, as well as in an unweighted condition.

Mordanting.

The silk is worked for 1/4 hour in a bath of

chloride of chrome 32° Tw. B. A. S. F.

and let soak in it for 12 hours, taking care that it is evenly penetrated and completely soaked in the mordant. It is now wrung, squeezed or hydro-extracted, washed well, if possible in running water, then worked well for 1/4 hour in a fixing bath of

silicate of soda 1° Tw.

After being well washed, the silk is dyed without drying.

The chloride of chrome bath can be repeatedly used after having been brought up to the original strength of 32° Tw. by adding

chloride of chrome 52° Tw. B. A. S. F.,

but the fixing bath must be prepared fresh each time.

Dyeing.

The dyeing is done in a concentrated bath containing

7 parts dyestuff
100 water.

The silk is entered at a temperature of 85° F., and heated up slowly during 3/4 hour to the boil, which is continued for 1 hour, and then washed well.

The dye-bath is not exhausted, but can be repeatedly used after adding

3 to 4 parts of dyestuff

for every fresh lot of goods.

Soaping and brightening.

In order to increase the fastness and brilliancy of the shade and to obtain a good "handle" and gloss, the dyed silk is boiled for 1/4 hour in a bath of

2 parts soap
1000 » water.

Now wash well, and work for 1/4 hour at a temperature of 120° F. in a bath of

20—25 parts acetic acid 9° Tw. (30%)
1000 » water

then wring out and dry without washing.

In shading it is not necessary to cool down the bath, but the silk is lifted out, and the dye dissolved in water is added to the boiling bath.

Suitably constructed wooden vats are best for dyeing silk.

The above process is especially adapted for

Alizarine Black WR, SW, and SRW,

but other Alizarine Colours can be used for shading purposes, for instance a part of the *Alizarine Black* is replaced by *Alizarine Blue*, *Anthracene Blue*, *Alizarine Indigo Blue* for a bluish black; by *Galloflavine*, *Coeruleïne*, *Carbazole Yellow W*, etc. for a deep black. A very deep dark blue can be obtained with *Alizarine Blue*, etc. a dark brown with *Anthracene Brown*, etc. and a dark reddish brown with *Alizarine Red*, etc.

No. 30. (No. 1007.)

Directions for dyeing

Light shades with Alizarine Colours on silk

(loose silk, yarn, and stuff)

in one bath.

The boiled-off silk can be dyed either in the weighted or in the unweighted condition. Add to the dye-bath: —

3 % alum
2 % oxalic acid } for alumina mordant,

or

3 % acetate of chrome 32° Tw. B. A. S. F.
1½ % oxalic acid } for chrome mordant.

Stir the requisite quantity of dyestuff with about 10 times its weight of cold water, and pass through a fine sieve into the dye-bath, which should have a temperature of 85° F.

The silk is entered and worked for ¼ hour in the cold, then heated during ¾ hour to the boil and boiled for 1 hour.

After being well washed the silk is boiled for ¼ hour in a bath containing

2 parts soap in
1000 » water

then washed again and brightened by working for ¼—½ hour in a bath of

20—25 parts acetic acid 9° Tw. (30 %)
1000 » water.

Finally wring, and dry without washing.

No. 31. (No. 397.)

Directions for dyeing

Alizarine Colours on silk

(loose silk, yarn, and stuff).

Iron mordant.

Mordanting.

In this process the boiled-off silk is weighted at the same time. It is immersed for two hours in a solution of

chloride of tin 52° Tw.,

then wrung out, well washed in water, and afterwards soaped for two hours in a bath of

60% soda crystals } reckoned on the weight of the silk
5% soap }

at a temperature of about 95° F., and washed well.

Now work for 1/4 hour in a solution of

nitrate of iron 52° Tw.
(basic sulphate of iron)

and again wash well, then boil for 1 hour with

15% soap (reckoned on the weight of the silk)

and well wash again.

To produce a bluish shade, work the silk for 1/2 hour in a bath of

10% yellow prussiate of potash } reckoned on the weight of the silk
12% hydrochloric acid 32° Tw. }

at a temperature of 140° F., wring and wash well.

The goods are now placed in a boiling bath of

50% cutch (reckoned on the weight of the silk)

and allowed to remain in it for 2 hours, after which the silk will be ready for dyeing.

The silk is also weighted with the above-described mordanting operations, and the weighting can be increased by repeating the operations once or several times, on the other hand it can be reduced by omitting the tin ground.

The chloride of tin, nitrate of iron, and cutch-baths, can be repeatedly used after having been restored to their original strength, but the prussiate of potash must always be prepared afresh.

Dyeing.

The dye-bath which should have a temperature of about 140° F., is prepared by adding

5 % soap (calculated on the weight of the silk),

and then making it slightly acid by addition of about

3 parts acetic acid 9° Tw. (30 %)

for every 1000 parts of dye-liquor.

For water of greater hardness the addition of acetic acid must be correspondingly increased.

The dyestuff is stirred with about 10 times its weight of cold water, and added through a fine sieve to the dye-bath, and the silk then entered at a temperature of about 140° F. It is worked for 1/2 hour at this temperature, then gradually raised to the boil which is continued for 1 1/2 hours. It is advisable to lift the silk out before the bath begins to boil, and after the boiling point has been reached, the steam is shut off and the silk entered and worked for 1/4 hour and the bath again heated up to boiling.

Soaping and brightening.

In order to increase the brilliancy and fastness of the colours, and to obtain a good gloss and "handle", the dyed silk is boiled for 1/4 hour in a bath containing

10 parts soap
1000 » water

then well washed and worked for 1/4 hour in a warm bath of

20—25 parts acetic acid 9° Tw. (30 %) in
1000 » water.

Finally wring, and dry without washing.

In shading it is not necessary to cool down the bath; the dyestuff may be added to the boiling dye-liquor.

The process is very well suited for

Alizarine Black,

especially for the brands *WR, SW, SRW paste,* and for

Alizarine Blue Black SW and *W paste,*

but *Alizarine Blue, Alizarine Red, Galloflavine,* etc. may also be employed for shading purposes.

No. 32. (No. 382.)

Directions for printing

Alizarine Colours on silk

(yarn and cloth).

The boiled-off silk requires no further preparation before printing.

Thickenings.

Gum thickening.

10	lbs.	gum
1	gall.	water.

Starch thickening.

2	lbs.	wheat starch
5	»	gum tragacanth solution (60 : 1000)
1¼	»	olive oil
2	gall.	water.

Printing Colours.

1. **Alizarine Red paste** (alumina mordant).

20	lbs.	Alizarine V1, SX, RG 20 %
12	»	sulphocyanide of alumina 32° Tw.
4	»	acetate of lime 15° Tw.
5	»	mordant OX (oxalate of tin 25° Tw.)
54	»	gum thickening
5	»	Turkey-red oil D
100	lbs.	

2. **Alizarine Red paste** (chrome mordant).

15	lbs.	Alizarine V1, SX, RG 20 %
14	»	sulphocyanide of chrome 39° Tw. B.A.S.F.
7	»	acetate of lime 15° Tw.
4	»	acetic acid 9° Tw. (30 %)
55	»	starch thickening
5	»	Turkey-red oil D
100	lbs.	

3. **Alizarine Red S powder** (alumina mordant).

6	lbs.	Alizarine Red dissolved in
14	»	water
12	»	sulphocyanide of alumina 32° Tw.
4	»	acetate of lime 15° Tw.
5	»	mordant OX (oxalate of tin 25° Tw.)
54	»	gum thickening
5	»	Turkey-red oil D
100	lbs.	

4. **Alizarine Orange** (alumina mordant).

25	lbs.	Alizarine Orange A or D 15 %
20	»	acetate of alumina 15° Tw.
5	»	acetate of lime 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
45	»	starch thickening
100	lbs.	

5. **Alizarine Orange** (chrome mordant).

25	lbs.	Alizarine Orange A or D 15 %
5	»	sulphocyanide of chrome 39° Tw. B.A.S.F.
5	»	acetic acid 9° Tw. (30 %)
3	»	tartaric acid (finely powdered)
62	»	gum thickening
100	lbs.	

6. **Alizarine Maroon** (alumina mordant).

15	lbs.	Alizarine Maroon 20 %
15	»	sulphocyanide of alumina 32° Tw.
5	»	acetate of lime 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
60	»	gum thickening
100	lbs.	

7. **Alizarine Maroon** (chrome mordant).

15	lbs.	Alizarine Maroon 20 %
10	»	acetate of chrome 32° Tw. B.A.S.F.
5	»	acetic acid 9° Tw. (30 %)
70	»	gum thickening
100	lbs.	

8. **Alizarine Blue S powder** (chrome mordant).

15	lbs.	Alizarine Blue S powder, dissolved in
10	»	cold water
15	»	sulphocyanide of chrome 39° Tw. B.A.S.F.
3	»	tartaric acid (finely powdered)
57	»	gum thickening
100	lbs.	

9. **Alizarine Indigo Blue S paste** (chrome mordant).

30	lbs.	Alizarine Indigo Blue S paste
$7^1/_2$	»	sulphocyanide of chrome 39° Tw. B. A. S. F.
3	»	tartaric acid (finely powdered)
$59^1/_2$	»	gum thickening
100	lbs.	

10. **Alizarine Green S paste** (chrome mordant).

30	lbs.	Alizarine Green S paste
$7^1/_2$	»	sulphocyanide of chrome 39° Tw. B. A. S. F.
3	»	tartaric acid (finely powdered)
$59^1/_2$	»	gum thickening
100	lbs.	

11. **Anthracene Blue R, B, G, GG, G extra** (alumina mordant).

10	lbs.	Anthracene Blue paste
10	»	acetate of alumina 15° Tw.
5	»	acetic acid 9° Tw. (30 %)
75	»	gum thickening
100	lbs.	

12. **Anthracene Blue R, B, G, GG, G extra** (chrome mordant).

10	lbs.	Anthracene Blue paste
5	»	acetate of chrome 32° Tw. B. A. S. F.
5	»	acetic acid 9° Tw. (30 %)
80	»	gum thickening
100	lbs.	

13. **Anthracene Brown** (chrome mordant).

25	lbs.	Anthracene Brown (20 %)
15	»	sulphocyanide of chrome 39° Tw. B. A. S. F.
8	»	acetic acid 9° Tw. (30 %)
1	»	tartaric acid (finely powdered)
5	»	glycerine
46	»	gum thickening
100	lbs.	

14. **Galleïne** (chrome mordant).

30	lbs.	Galleïne
5	»	sulphocyanide of chrome 39° Tw. B. A. S. F.
3	»	tartaric acid (finely powdered)
62	»	gum thickening
100	lbs.	

15. **Coeruleïne** (chrome mordant).

10	lbs.	Coeruleïne S powder, dissolved in
15	»	water
5	»	sulphocyanide of chrome 39° Tw. B. A. S. F.
5	»	acetic acid 9° Tw. (30 $^0/_0$)
3	»	tartaric acid (finely powdered)
62	»	gum thickening
100	lbs.	

16. **Galloflavine** (chrome mordant).

10	lbs.	Galloflavine
2	»	sulphocyanide of chrome 39° Tw. B. A. S. F.
5	»	acetic acid 9° Tw. (30 $^0/_0$)
83	»	starch thickening
100	lbs.	

17. **Alizarine Black** (chrome mordant).

25	lbs.	Alizarine Black S paste
5	»	sulphocyanide of chrome 39° Tw. B. A. S. F.
5	»	acetic acid 9° Tw. (30 $^0/_0$)
2	»	tartaric acid (finely powdered)
63	»	gum thickening
100	lbs.	

18. **Carbazole Yellow W.**

1	lbs.	Carbazole Yellow W, dissolved in
19	»	water
$2^1/_2$	»	acetate of chrome 32° Tw. B. A. S. F.
5	»	acetic acid 9° Tw. (30 $^0/_0$)
$72^1/_2$	»	gum thickening
100	lbs.	

19. **Mordant Yellow G and R.**

2	lbs.	Mordant Yellow, dissolved in
18	»	water
5	»	acetic acid 9° Tw. (30 $^0/_0$)
10	»	acetate of chrome 32° Tw. B. A. S. F.
65	»	gum thickening
100	lbs.	

Steaming, etc.

After printing the silk is well dried, steamed 1 hour at $^1/_4$ atmosphere pressure, then washed and soaped.

All the Alizarine Colours are adapted for printing on silk, but of Alizarine Black, only the brands *S* and *SR paste* are suitable.

F.

Silk Union.

SILK union goods composed of mixtures of

silk and cotton or
silk and wool,

are much used in the dyed condition for dress-goods, ribbons, umbrellas, etc., and the Alizarine Colours can also be employed in this branch of the textile industry.

Union of silk and cotton.

The silk and cotton can be mordanted together in one bath by immersing the goods for 12 hours in a bath of

acetate of alumina 9° Tw.
or
chloride of chrome 32° Tw.

and then washing in running water. The dyeing is carried out according to the directions given for silk.

Union of wool and silk.

When dyeing union prepared from silk and wool, the two materials must be mordanted in separate operations.

The wool is first mordanted by boiling with

3 % bichromate of potash
2½ % tartar,

and the silk by immersing the material in

chloride of chrome 32° Tw.

It is dyed in the same way as wool.

In both cases the result obtained depends to a large extent upon the kind of the texture, and also on the proportion in which the quantity of silk stands to that of cotton or wool respectively.

G.

Colour Lakes.

THE Alizarine Colour lakes, i. e. their combinations with the various metallic salts, are remarkably fast to light and water, and are therefore much used for lithographic purposes (coloured prints, etc.) and for painting purposes, etc.

The alumina lakes of the Alizarine Colours have proved to be especially suitable, since they are much more brilliant than the chrome lakes.

The conditions necessary for producing a fine lake are the same as for dyeing the textile fibre; thus for instance, Alizarine Red requires an addition of lime salts and Turkey-red oil, and also the application of a high temperature.

The lakes are produced by mixing the Alizarine Colours in alkaline solution with the various mordants such as alumina, lime, and tin salts and Turkey-red oil. The lake is formed in the cold, but possesses however a dull and unsightly appearance, and only obtains brilliancy and vivacity on boiling.

The Alizarine Colours used for lithographic purposes, etc. contain a greater or smaller amount of a colourless white body the so-called substratum, the quantity present depending on the depth of tone. In most cases this consists of phosphate of alumina, which is produced at the same time as the lake itself.

To produce beautiful brilliant lakes, it is absolutely necessary that the water and chemicals used be free from iron, as even slight traces of iron have an injurious effect, as they give rise to dark and unsightly lakes.

The following Alizarine Colours are suitable for producing alumina lakes, and must be divided into 3 groups on account of their chemical nature: —

1st group	*Alizarine Red paste* *Purpurine* *Alizarine Maroon* *Anthracene Blue* *Galleïne* *Anthracene Brown* *Galloflavine* *Alizarine Black*
2nd group	*Alizarine Orange* *Alizarine Blue* *Alizarine Indigo Blue* *Alizarine Green*
3rd group	*Coeruleïne.*

The lakes are produced as follows: —

First group.

These dyestuffs form readily soluble salts with alkalies, and are therefore dissolved in soda, then mixed with solutions of phosphate of soda and Turkey-red oil F. This solution is then mixed with another of sulphate of alumina, acetate of lime and chloride of tin, which causes the precipitation of the lake, the brilliant shade of which is developed by boiling.

Second group.

The dyes of the second group are difficultly soluble alkali salts, and are therefore not dissolved in soda, but simply stirred with water. The lake is produced in exactly the same way as group I.

Third group.

Coeruleïne, the only representative of this group, requires a different treatment. It is dissolved in bisulphite of soda, the solution filtered and the lake precipitated by means of alum, then after further addition of bisulphite, it is developed by boiling.

In all cases the lake is separated by filtering, well washed, and then dried at the ordinary temperature.

Particularly brilliant shades are obtained if the lake after it has been filtered, but not washed, is steamed in suitable apparatuses under pressure, and this operation is especially recommended for bright brilliant Alizarine Red lakes.

No. 33. (No. 431.)

Directions

for producing alumina lakes of the Alizarine dyestuffs.

Alizarine Red paste 20 %
Purpurine paste 20 %
Alizarine Maroon 20 %
Anthracene Brown 20 %
Anthracene Blue R, B, G, GG, G extra
Galleïne 10 %
Galloflavine paste and
Alizarine Black R paste.

Dissolve

1 lb. Alizarine paste 20 % or
1 » Purpurine 20 % or
1 » Alizarine Maroon 20 % or
1 » Anthracene Brown 20 % or
2 lbs. Anthracene Blue R, B, G, GG, G extra respectively, or
2 » Galleïne 10 % or
2 » Galloflavine paste or
$1^1/_4$ » Alizarine Black R in

a. $6^1/_2$ oz. calcined soda
$2^1/_2$ gall. water

also

b. $1^3/_4$ lbs. phosphate of soda in
2 gall. water

and

c. $6^1/_2$ oz. Turkey-red oil F in
$^1/_2$ gall. water.

The solutions a, b and c are poured together forming solution I.

Dissolve further:

d. 1 lb. 1 oz. sulphate of alumina
(containing 18 % alumina) in
2 gall. water

e. 4 oz. acetate of lime in
$^1/_4$ gall. water

and

f. $1^1/_4$ oz. chloride of tin in
1 lb. water.

The solutions d, e and f are poured together forming solution II. Solution I is now poured with constant stirring into solution II, the mixture is heated up to boiling and the boiling continued for 1 hour, then the lake is removed by filtering, washed well, and dried at the usual temperature.

To produce an especially brilliant Alizarine Red lake, filter off, and steam without washing in a suitable apparatus under pressure.

If lighter lakes are wanted, the amount of sulphate of alumina must be increased, also the amount of calcined soda and phosphate of soda must also be proportionally increased.

For every

1 lb. 1 oz. sulphate of alumina a further
1 » $5^3/_4$ » phosphate of soda and
5 » calcined soda

must be used.

II.

Alizarine Orange A 15 %
Alizarine Blue S paste
Alizarine Indigo Blue S paste
Alizarine Green S paste.

A slight alteration in the method of working is required for these dyestuffs. The dyestuff is not dissolved in a soda solution, but is diluted down with 5 times its weight of water and added to solution II, into which solution I is then slowly poured. After this the method of working is the same as stated under I.

The following quantities of dyestuff are required: —

1 lb. $5^1/_2$ oz. Alizarine Orange A 15 % or
$1^1/_4$ lbs. Alizarine Blue S paste or
$1^1/_4$ » Alizarine Indigo Blue S paste or
$1^1/_4$ » Alizarine Green S paste.

III.

Coeruleïne.

Mix: —

1 lb. Coeruleïne II with
$1^1/_4$ gall. water and add
2 lbs. bisulphite of soda 72/77° Tw.

and allow to stand for 12 hours at ordinary temperature.

Now add $1^1/_4$ gall. water, heat up with steam to 160° F., filter, and dilute the clear solution with 5 gall. water.

The solution is now heated up to boiling and 2 lbs. of potash alum powder added, then boiled for $^1/_2$ hour after which $1^1/_2$ lbs. bisulphite of soda 72—77° Tw. are added, and the boiling continued for another $^1/_2$ hour. Finally filter, wash, and dry the lake at ordinary temperature.

H.

Leather.

THE Alizarine Colours can also be used for dyeing leather, but so far they have only been used to a limited extent for this purpose, chiefly owing to the fact that a high temperature is required for developing their good qualities, and this has a detrimental effect upon most qualities of leather.

Besides, leather must be dyed very evenly, and this is very difficult to manage with most of the Alizarine dyes. Again, the mordanting and dyeing operations are much more troublesome than those of the Aniline Colours, and finally, the high price of the Alizarine Colours also retards their introduction into leather-dyeing.

Besides the various kinds of leather: —

alum-tanned or kid leather
chamois or wash leather
bark-tanned leather,

the product of a new method of tanning has recently been introduced into the market i. e.

chrome-tanned leather,

which is tanned by means of chrome salts and is said to offer special advantage for a good many purposes.

All these qualities can be dyed according to the

dipping process as well as by the brushing process.

In the dipping process, the leather is dyed both on the flesh and grain sides by repeatedly dipping it into the dye-liquor, whereas in the brushing process, the colour is brushed on and only applied to the grain side.

When using the Alizarine Colours the various kinds of leather must be first prepared with a mordant.

The leather must first be kneaded for one hour with the smallest possible quantity of cold water, in order to get it as completely soaked as possible, and render it fit to absorb the mordant and dyestuff evenly.

The various kinds of leather then require a further preparatory treatment such as, for instance, treatment of alum-tanned (kid) leather with yolk of eggs.

Dipping process.

In this process the leather which has been prepared as above is dipped several times in a mordanting solution of alum, acetate of chrome or acetate of iron, and absorbs part of the mordant; the excess is removed by washing with a little water.

The leather is now dyed by dipping it several times into solutions of the Alizarine dyestuffs at a temperature of 104° F. until the desired shade is attained.

Finally the excess of dyestuff is washed off with a little water, and the leather further treated in the usual way.

Brushing process.

In this process the prepared leather is stretched with its grain side upwards upon a flat table or glass plate, and first brushed with a cold solution of

1 lb. carbonate of ammonia
10 gall. water.

The object of this operation is to facilitate the penetration of the dyestuff. The solution of the Alizarine Colours is now brushed on at a temperature of about 104° F., and this must be done as quickly and evenly as possible. The leather absorbs the dyestuff which is then fixed by being brushed over with a solution of the mordant i. e. alum, acetate of chrome, acetate of iron.

Darker shades are obtained by repeating the brushing with dye-liquor and mordant once or several times.

In dyeing Alizarine Red on alumina mordant, the leather is also brushed with a solution of acetate of lime, as the latter is necessary for producing a fine red. When the dyeing process is finished, the leather is again stretched on a glass plate, but this time with the undyed flesh side uppermost, and the liquid is removed by sharply squeezing with a wooden implement.

The dyed leather is now further treated and dressed in the usual way according to its quality.

Chrome-tanned leather.

In this case the mordanting operation is dispensed with, as the chrome contained in the leather from the tanning process attracts the Alizarine dyestuffs both in the dipping and brushing process, and combines with them forming coloured lakes.

The following Alizarine powder brands soluble in water are the most suitable for leather-dyeing: —

Alizarine Red SWB and SWR powder
(alumina, chrome and iron mordant)
Alizarine Red S powder
(alumina, chrome and iron mordant)
Alizarine Orange SW powder
(alumina and chrome mordant)
Anthracene Blue SWG powder
(alumina and chrome mordant)
Anthracene Brown SW powder
(alumina and chrome mordant)
Galleïne SW powder
(alumina and chrome mordant)
Coeruleïne SW powder
(alumina and chrome mordant)
Mordant Yellow G and R
(alumina and chrome mordant)
Carbazole Yellow W
(alumina and chrome mordant).

No. 34. (No. 410.)

Directions for dyeing

Alizarine Colours on alum-tanned leather.

Alum-tanned leather is kneaded for 1 hour with as small a quantity of water possible, in order to get it thoroughly and evenly penetrated by the water, then prepared in the usual way by kneading for $^3/_4$ hour with yolk of eggs and water.

The leather is now placed grain side up on a smooth table (or better on a glass plate), well and evenly spread out, without however squeezing it.

Now brush it several times with a cold solution of

1 lb. carbonate of ammonia
10 gall. water

and then brush on the dyestuff dissolved in 50—100 times its quantity of water at 104° F., giving it several coatings till the required shade has been attained.

Finally the dyestuff is fixed by brushing the leather with the following mordants:—

1. Alumina mordant.

4 oz. alum dissolved in
1 gall. water.

2. Chrome mordant.

Acetate of chrome $1^1/_2{}^0$ Tw.

3. Iron mordant.

Acetate of iron $1^1/_2{}^0$ Tw.

The mordant used must of course be selected according to the desired shade.

When dyeing Alizarine Red on alumina mordant, the leather must also be brushed several times with a solution

1 lb. acetate of lime (solid) in
10 gall. water

and for very dark shades, the alternate brushings with mordant and dye-liquor must be repeated several times.

When the required shade has been arrived at, the skin is turned with the flesh side up and the moisture squeezed out vigorously with a wooden scraper. The leather is dried at about 104° F. and then put into damp sawdust, after which it is subjected to the various further dressing operations.

No. 35. (No. 1008.)

Directions for dyeing

Alizarine Colours on chrome-tanned leather.

The chrome-tanned leather previous to dyeing, is completely and evenly moistened by being kneaded for one hour with a little water.

The dye-bath is prepared at a temperature of 120° F. by adding the dyestuff dissolved in hot water through a fine sieve, and the leather is immersed in it for 20 minutes.

The dyestuff is fixed by adding

2 lbs. acetic acid 9° Tw. (30 %)

for every 100 gall. liquor, and turning for 10 minutes further. Finally, wash and finish in the usual way.

J.

Paper.

THE Alizarine Colours are only applicable in quite particular cases for dyeing paper pulp, their high price being a great drawback since papermakers require very cheap colouring matters. It is not likely that the Alizarine Colours will meet with general adoption in this branch of dyeing, since the method of fixation is much more troublesome than that of the Aniline Colours, and also they require a higher temperature for the formation of lakes.

Further the Alizarine Colours cannot be used for dyeing sized (writing) paper, as they must be used in alkaline solutions, and the alkali would destroy the sizing.

Thus only the dyeing of unsized (blotting) paper remains, and this can be done just as well with ready made lakes, as the paper pulp (blotting paper as well as wood pulp) shows but little affinity for the colour lake, and only contains it as a mechanical admixture.

EINLEITUNG.

Die Schwierigkeiten, die sich beim Entwurf und Bau von Turbodynamos ergeben, sind durch die einer gegebenen Leistung entsprechenden hohen Umlaufzahlen bedingt, wie sie die direkte Kupplung mit den bis jetzt üblichen Dampfturbinen mit sich bringt. Diese Umlaufzahlen sind in meiner Broschüre „Die Dampfturbinen“ unter „Praktische Daten“ ausführlich zusammengestellt; dort finden sich auch noch andere für den Konstrukteur von Turbodynamos wichtige Gesichtspunkte betr. Dampfturbinen aufgeführt, namentlich in konstruktiver Hinsicht (Lager etc.) hängt jenes kleine Werk eng mit dem vorliegenden zusammen.*)

Die hohen Umlaufzahlen von Turbodynamos führen zu Umfangsgeschwindigkeiten des rotierenden Teiles von 60 bis

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*) Zum Studium der elektrischen Grundlagen für den Entwurf von Turbodynamos verweise ich auf meine zwei grösseren Werke „Elektrische Maschinen und Apparate“, sowie „Elektrische Maschinen und Anlagen“, wo die für Turbodynamos wichtigen Probleme bereits im Zusammenhang erörtert sind. Über Turbodynamos habe ich Aufsätze veröffentlicht in „Z. V. D. I.“, 1905, S. 762 ff.; „Zeitschr. f. d. g. Turbinenwesen“, 1905, Heft 1—3; „Z. f. E.“, 1904, 7. und 14. Februar und 1905, S. 1, sowie S. 495; „Electrical World“, 1904, 19. und 26. Mai und 15. Oktober. Weitere Turbodynamos finden sich im Handbuch der Elektrotechnik Bd. IV (2. Aufl.)

K.

Appendix.

THE dyestuffs

Fast Black B and BS

and

Indophor

which are exclusively used for cotton, must be considered in the appendix to the Alizarine Colours, although they are really different as regards their chemical nature and mode of application.

Patent Fast Black B and BS.

IN 1894 the Badische Anilin- & Soda-Fabrik discovered a black dyestuff by the action of sulphide of sodium on dinitronaphthaline viz: —

Fast Black B paste.

In the same year this colour was patented, and introduced into the market in the form of a black insoluble paste.

In the following year this firm produced and patented the brand

Fast Black BS paste,

and offered it to the trade in the form of a soluble black paste, which dissolves in water to form a red violet solution.

Fast Black B paste is only soluble in concentrated solutions of soda and sulphide of sodium, and the dyeing process for this peculiar dyestuff depends on these properties.

Since the dyeing must always take place in a strong alkaline bath, this dyestuff cannot be used for the animal fibres which are more or less injured by strong alkalies.

For this reason Fast Black is only suitable for dyeing cotton, and cannot be used for wool or silk as they are rendered brittle by the action of alkalies.

Fast Black B can be dyed in two different ways, viz: —

1) in a boiling bath with soda,
2) in a cold bath with sulphide of sodium.

1. Dyeing Fast Black B in a boiling bath with soda.

Fast Black B as already stated dissolves in a boiling concentrated soda solution, and in this condition can dye cotton gray to black according to the quantity of dyestuff employed.

For this purpose, the necessary quantity of soda is dissolved in hot water, and the dyestuff stirred with 10 times its quantity of hot water added through a fine sieve to the dye-bath, which is then heated up to the boil and the cotton entered.

The cotton is boiled for $1^1/_2$ hours in this bath and is frequently moved about, then wrung out and washed in plenty of running water. The bath is not exhausted, but can be used for further operations after adding the necessary amount of dyestuff and sulphide of sodium.

2. Dyeing Fast Black B in a cold bath with sulphide of sodium.

Fast Black B dissolves in sulphide of sodium with a blue violet colour, which gives up dyestuff to the fibre even in the cold.

The cold dye-bath is prepared as follows: — The sulphide of sodium is dissolved in hot water and the dyestuff added to this solution, then after $^1/_4$ hours stirring it is added to the cold dye-bath.

The dye-bath is well stirred, the cotton entered and worked in it for 1—1$^1/_2$ hours, after which it is wrung out and washed in plenty of running water. The bath is not exhausted, but can be used again after adding adequate quantities of dyestuff and sulphide of sodium.

The solubility of Fast Black B in sulphide of sodium, led to the production of the brand —

Patent Fast Black B S,

which when dissolved alone in water, but better with addition of sulphide of sodium, is suitable for dyeing cotton according to the process described under 2.

Fast Black B and BS are suitable for dyeing cotton in the loose state, as yarn or piece-goods. Since the alkaline baths would severely affect the skin, the working of the goods in the usual way with the hands should be avoided, unless the hands are protected by India rubber gloves.

The best material for the dyeing vessels is iron, but earthenware, stone, and wooden vessels may also be used.

Copper must be avoided, as it is vigorously acted on by sulphide of sodium and destroyed by it in course of time.

The dyed cotton is squeezed or wrung out, and at once washed in plenty of (if possible running) water until it gives off no more dye, and by soaping after the washing it becomes quite clean.

By treating the Fast Black dyeings with blue vitriol, the black becomes fuller and deeper, but after some time it assumes a brownish tint, and for this reason the copper treatment cannot be recommended.

Fast Black dyeings can be topped with Aniline Colours, and can therefore be shaded at pleasure, the Fast Black ground acts as a mordant to the Aniline Colours, which are therefore fixed very fast upon the fibre. The most suitable Aniline Colours are Methylene Blue, Saffranine, Indoine Blue, etc., and they are dyed by working for $^1/_2$ hour in a bath at about 85° F. under addition of a little alum. The Alizarine Colours (Alizarine Blue, Alizarine Indigo Blue, Alizarine Green, etc.) can also be employed for topping Fast Black by the one-bath method, using acetate of chrome as mordant.

Fast Black dyeings are turned brown by the action of oxidizing agents, such as bleaching powder, permanganate of potash, bichromate of potash, etc. and in this way a very fast brown can be obtained. For this purpose it is best to use bichromate of potash and sulphuric acid.

However owing to the rather quick and energetic action of chromic acid, such dyeings are apt to turn out rather streaky, especially when dyeing large lots.

Dyeings done with Fast Black B and BS either with or without a topping of Aniline Colours, are very fast to light, and in this respect are better than logwood blacks, and are also as good as Aniline Black dyeings.

Fast Black is very fast to washing and does not stain interwoven white cotton even with severe soaping, but a topping of Aniline Colours will however bleed a little on being severely treated. The fastness to washing is increased by boiling with dilute acetic acid.

Fast Black dyeings are also very fast to acids, and can therefore be used for dyeing the warps of half-woollen cloths (Italians), which are to be dyed with Aniline Colours in an acid bath. Stoving has next to no effect on Fast Black dyeings, and they also resist the shrinking operation very well, but as already mentioned they are not fast to chlorinc since oxidizing agents change them into the Brown of Fast Black. Cotton dyed with Fast Black is also perfectly fast to rubbing, if it has been well and properly washed out.

The chief advantage of Fast Black over Aniline Black is that it does not tender the fibre, but rather tends to increase the durability and elasticity of the cotton, whereas it is well-known that Aniline Black injures the fibre very much, so much in fact, that it cannot be used at all for the finer numbers of yarns or textures.

The method of applying Fast Black is very simple, and if all precautions are properly observed absolutely reliable.

The price of Fast Black is at the present time about the same as that of a good Aniline Black, and so considering its better qualities it can be decidedly used with advantage.

No. 36. (No. 413, 420, 428, 429.)

Directions for dyeing

Fast Black B and BS

(on cotton).

The cotton (loose cotton, yarn or piece-goods) is cleansed and thoroughly moistened by boiling it in water containing soda or caustic soda, then washed and dyed without drying.

1. Dyeing at the boil.

For 100 parts cotton.

Only the brand

Fast Black B paste

is suitable for this purpose.

A bath is prepared from

20—60 parts Fast Black B paste
150 » soda ash
1000 » water

and heated up to boiling. The Fast Black is stirred with three times its quantity of hot water, added through a fine sieve to the dye-bath and the soda is dissolved in the boiling bath. The cotton is now entered and boiled for 1$^1/_2$ hours, loose cotton being moved with a stick, whereas yarn is turned on rods.

On account of the strong alkaline nature of the dye-bath, working with the hands must be avoided, unless they are protected with India rubber gloves.

Piece-goods are dyed in a jigger, which should be so constructed that the material always remains below the surface of the dye-liquor.

After dyeing, the cotton is squeezed, wrung or hydro-extracted, and the liquor wrung out from the cotton is put back into the dye-bath. Finally the cotton after being wrung out is immediately washed well in running water and soaped at the boil.

The dye-bath is not exhausted, but can be used again after adding the necessary quantities of Fast Black and soda.

15—25 parts Fast Black B paste
25 » soda ash

according to shade, are dissolved in hot water and added.

2. *Dyeing in a cold bath.*

The following brands are suitable for this process

Fast Black B
Fast Black BS.

Prepare the dye-bath with

1 part Fast Black B or BS,

or a mixture of the two brands and

1 part sulphide of sodium
8—12 parts water (according to depth of shade).

The sulphide of sodium is dissolved in about 3 times its quantity of hot water, and the dyestuff added to this solution which is then stirred for $^1/_4$—$^1/_2$ hour and the remainder of the water added.

The cotton is entered in this solution and worked for 1—2 hours, loose cotton being worked with a stick, and yarn on rods and not with the hands, unless they are protected by India rubber gloves. Piece-goods are dyed in a jigger, which should be so constructed that the material always remains below the surface of the liquid.

Now wring well, squeeze or hydro-extract, and return the liquid which runs from the cotton to the dye-bath, after wringing wash well at once in plenty of, if possible, running water, and treat in a boiling soap-bath.

The bath is not exhausted but can be used again after adding

30—50 % Fast Black
15—25 % sulphide of sodium

according to the shade and quality of the cotton. The sulphide of sodium is dissolved in a part of the old dye-bath, stirred together with the dyestuff for $^1/_4$—$^1/_2$ hour and then added to the bath.

Topping with Aniline Colours.

Cotton which has been dyed according to the two above processes, can be dyed without any further preparation with Aniline Colours, such as, Methylene Blue B, Saffranine T, Indoine Blue BB, etc. in a bath of about 95° F.

The dyestuff (0·2—0·5 % of the weight of the cotton) and 1 % alum are dissolved in water, and the cotton dyed with Fast Black is worked for about 20 minutes in this solution.

Topping with Alizarine Colours.

Prepare according to the shade desired, a cold bath with:—

$$2\text{—}5\ \% \begin{cases}\text{Alizarine Blue S paste}\\ \text{Alizarine Indigo Blue S paste}\\ \text{Alizarine Green S paste}\end{cases}$$

3 % acetate of chrome 32° Tw. B. A. S. F.

Enter the cotton cold, and heat up gradually during $^1/_2$ hour to the boil working the goods at the same time, and continue the boiling $^1/_2$ hour, then finally wash well.

Brown with Fast Black

The cotton dyed with Fast Black is worked at 75° F. for $^1/_2$ hour in a bath containing:

5 parts bichromate of potash
5 „ sulphuric acid 168° Tw.
1000 „ water,

and then well washed.

When working larger lots the cotton must be worked quickly and also be entered into the bath as rapidly as possible, or else the skeins will come up uneven and streaky.

Remarks.

The dye-vats, apparatuses, etc. are best constructed of iron, but vessels of earthenware or wood may also be utilized; copper must however be avoided, as it is affected by sulphide of sodium.

The goods must not be worked with the hands unless they are protected by India rubber gloves, as the alkaline dye-liquor affects the skin.

Indophor.

INDOPHOR was offered to the trade by the Badische Anilin- & Soda-Fabrik in 1895, in the form of a greenish to bluish insoluble powder for the purposes of calico-printing. It is soluble in borax, alcohol and glycerine, and this property is made use of in calico-printing, as it admits of better distribution in the printing colour.

When suitably treated with alkalies it is changed by oxidation into indigo, which is at the same time fixed on the fibre, and either chloride of iron or the oxygen of the air can be used as oxidizing agents, the latter being brought into effect in a steaming process.

Indigo blue can be produced on the fibre by means of Indophor in 4 different ways.

I. *By printing the cotton cloth which has been saturated with a solution of borax with Indophor dissolved in borax, drying and passing through a bath of chloride of iron and hydrochloric acid.*

II. *By printing Indophor which has been ground up with water, or better still dissolved in glycerine upon cotton which has been prepared with soda, and developing the Indigo by drying.*

III. *By printing the Indophor dissolved in borax on cloth which has been prepared with soda, and developing the Indigo by steaming in a Mather and Platt apparatus.*

IV. *By printing the Indophor on unprepared cloth, and developing the Indigo by steaming in a Mather and Platt apparatus in an atmosphere of ammonia.*

The four different processes are employed for the following purposes: —

I. *For producing medium and light shades by printing-on.*

II. *For producing light shades by printing-on or padding.*

III. *For producing fine designs by printing-on (shirtings).*

IV. *For producing dark grounds by printing-on.*

Indophor is chiefly used for producing small designs in medium and light shades on cotton cloth, and the artificial Indigo developed on the fibre possesses all the properties of natural Indigo.

No. 37. (No. 422.)

Directions for printing and padding

Indophor (artifical Indigo) on cotton.

Artifical Indigo (from Indophor), is produced on the cotton fibre by printing or padding according to one of the following four processes; the one used depending on the shade required.

Process I

(for medium and light shades).

The cotton is padded with a solution of

6 lbs.	borax
10 gall.	water

then dried, and printed with a colour prepared from

1—8 lbs.	Indophor
20 ›	borax solution $4^{1}/_{2}$° Tw. { 1 lb. borax $1^{3}/_{4}$ gall. water
79—72 ›	gum tragacanth solution (50 : 1000)
100 lbs.	

and dried. After this work the cloth for 2—5 minutes in a cold solution of

10 lbs.	chloride of iron 52° Tw.
10 ›	hydrochloric acid 32° Tw.
80 ›	water
100 lbs.	

wash well, soap lightly, and dry.

Process II

(for light shades).

The cotton is padded in a solution of

soda ash 3° Tw. { 1 lb. soda ash
7 gall. water

then dried, and printed with a printing paste prepared as follows: —

$^{1}/_{4}$—1 lb.	Indophor well ground with
$9^{3}/_{4}$—9 lbs.	water or still better is dissolved in 10 times its weight of glycerine at about 120° F.
90 ›	gum tragacanth solution 50 : 1000
100 lbs.	

are stirred for $^{1}/_{4}$ hour on a water-bath, and then printed or padded on and dried at about 105° F., after which wash and soap lightly.

Process III

(for darker shades in fine designs).

The cotton is prepared as described in Process II and printed with a paste consisting of

6 lbs. Indophor
20 » borax solution { 1 lb. borax, $1^{3}/_{4}$ gall. water
74 » gum tragacanth solution 50:1000
100 lbs.

and dried, then steamed for 1—2 minutes in the Mather-Platt apparatus at 175—195° F., or hung up in the oxidizing room for $^{1}/_{4}$ hour at 105—120° F. Finally wash and soap.

Process IV

(for very dark shades which are to serve as grounds).

The cotton cloth requires no preparation. It is printed with a paste consisting of

6 lbs. Indophor
20 » borax solution { 1 lb. borax, $1^{3}/_{4}$ gall. water
74 » gum tragacanth solution 50:1000
100 lbs.

dried at about 85—105° F. and steamed for 10 minutes at 120—175° F. in the Mather-Platt apparatus into which ammonia fumes are passed, then washed and soaped lightly.

General Remarks.

As already mentioned the four processes are suited for the following purposes:—

Process I for printing-on medium and light shades.

Process II for printing or padding light shades.

Process III for printing-on fine designs (shirtings).

Process IV for printing-on dark grounds.

Durability of the printing colour.

The printing colour prepared according to processes I, III, and IV with borax only keep fit for use for about 12 hours, and must therefore only be prepared for immediate use.

The printing colour prepared according to process II without borax keeps for several days, and can also be used for process IV, but care must then be taken that the Indophor is well stirred with water.

To obtain a good printing colour the Indophor must be ground up to a finely divided paste; in processes I, III, and IV with the borax solution which is gradually added cold, and in process II by heating with water or still better with 10 times its quantity of glycerine on a water-bath.

L.

Table

of the

Alizarine Colours and their Methods of Application.

Brand	Paste or powder	Solubility in water	Shade on a mordant of		
			Alumina	Chrome	Iron
Alizarine V1 new	Paste 20 %, 40 %	Difficult to dissolve	Bluish Red	Bluish Claret	Violet
» *V1 old*	» 20 %, 40 %	»	»	»	»
» *V2a blue shade* . .	» 20 %, 40 %	»	»	»	»
» *V2a yellow shade* . .	» 20 %, 40 %	»	Shades ranging from bluish Red to Scarlet	Shades ranging from bluish Claret to yellowishClaret	Bluish Gray to dull Violet
» *V2*	» 20 %, 40 %	»			
» *V3*	» 20 %, 40 %	»			
» *GF*	» 20 %, 40 %	»			
» *GFX*	» 20 %, 40 %	»			
» *GFY*	» 20 %, 40 %	»			
» *GD*	» 20 %, 40 %	»	Scarlet		
» *GG*	» 20 %, 40 %	»	Between G D and G I		
» *GI*	» 20 %, 40 %	»	Yellowish Red	Yellowish Claret	
» *SX*	» 20 %, 40 %	»	Scarlet	Claret	
» *RA*	» 20 %, 40 %	»	Between S X and R G	Between S X and R G	
» *RG*	» 20 %, 40 %	»	Yellowish Red	Yellowish Claret	
Alizarine Red WB	» 20 %, 40 %	»	Bluish Red	Bluish Claret	. . .
» » *WR*	» 20 %, 40 %	»	Red	Shades ranging from bluish Claret to yellowishClaret	. . .
» » *WG*	» 20 %, 40 %	»	Scarlet		. . .
» » *WGG*	» 20 %, 40 %	»	Yellowish Red	Yellowish Claret	. . .
» » *SWB*	Powder	Soluble in water	Bluish Red	Bluish Claret	. . .
» » *SWR*	»	»	Between SWB and SWG	Between S W B and S W G	. . .
» » *SWG*	»	»	Scarlet	Claret	. . .
» » *S*	»	»	Bluish Red	Bluish Claret	. . .
» » *SF*	»	»	»	»	. . .
» » *SS*	»	»	Between S and S S S	Between S and S S S	. . .

Application

a) Cotton		b) Wool		c) Silk		d) Lake (Alumina)	
Application	Process	Application	Process	Application	Process	Shade	Process
*D & P	1. 2. 3. 4. 5. 6. 7. 9. 10. 11. 12.	. . . . .	. . . . .	*D & P	27. 28. 30. 32.	Bluish Red	33.
»	»	. . . . .	. . . . .	»	»	»	»
»	»	. . . . .	. . . . .	»	»	»	»
»	»	. . . . .	. . . . .	»	»	Shades ranging from bluish Red to yellowish Red	»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»		»
»	»	. . . . .	. . . . .	»	»	Yellowish Red	»
. . . . .	. . . . .	*D & P	13. 14. 15. 16. 17. 18. 21. 22. 24. 25. 26.	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	13. 14. 15. 16. 17. 18. 20. 21. 22. 24. 25. 26.	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26.	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—

Brand	Paste or powder	Solubility in water	Shade on mordant	
			Alumina	Chrome
Alizarine Red SSS	Powder	Soluble in water	Yellowish Red	Yellowish Claret
Purpurine	Paste 20 %	Difficult to dissolve	Red	Bluish Claret
Alizarine Orange A	Paste 15, 20, 30, 40 %	Slightly soluble	Orange	Reddish Brown
» » *D*	Paste 15, 20, 40 %	»	Reddish Orange	»
» » *W*	» 15, 20, 40 %	»	Orange	»
» » *SW*	Powder	Soluble in water	»	»
Alizarine Maroon paste . . .	Paste 10 %, 20 %	Difficult to dissolve	Bluish Claret	Dark Claret
» » *powder* . .	Powder	»	»	»
» *W paste* . .	Paste 10 %, 20 %	»	»	»
» » *W powder* .	Powder	»	»	»
Alizarine Blue X paste . . .	Paste 10 %, 20 %	Not soluble	. . . .	Reddish Blue
» » *R* » . . .	» 10 %, 20 %	»	. . . .	Dark reddish Blue
» » *S* » . . .	Paste	Soluble in water	. . . .	Reddish Blue
» *SR* » . . .	»	»	. . . .	»
» » *S powder* . . .	Powder	»	. . . .	»
» » *SR powder* . .	»	»	. . . .	»
» » *WX paste* . .	Paste 10 %, 20 %	Not soluble	. . . .	»
» » *WR* » . .	» 10 %, 20 %	»	. . . .	Dark reddish Blue
» » *WC* » . .	Paste	»	. . . .	»
» » *WN double new paste*	»	»	. . . .	»
» » *WRR paste* . .	»	»	. . . .	»
» » *XA* » . .	» 20 %	Fairly soluble	. . . .	Reddish Blue
» » *SW* » . .	»	Soluble in water	. . . .	»
» » *SRW* » . .	»	»	. . . .	Dark reddish Blue
» » *S W powder* . .	Powder	»	. . . .	Reddish Blue

Application

a) Cotton		b) Wool		c) Silk		d) Lake (Alumina)	
Application	Process	Application	Process	Application	Process	Shade	Process
. . .	. . . . .	*D & P	13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26.	—	—	—	—
*D & P	1. 2. 3. 4. 5. 6. 7. 9. 10. 11. 12.	. . . . .	. . . . .	—	—	Pink Madder Lake	33.
»	»	. . . . .	. . . . .	*D & P	27. 28. 30. 32.	Orange	
»	»	. . . . .	. . . . .	»	»	—	—
. . . . .	. . . . .	*D & P	13. 14. 15. 16. 17. 18. 19. 21. 22. 25. 26.	—	—	—	—
. . . . .	. . . . .	»	13. 14. 15. 16. 17. 18. 20. 21. 22. 25. 26.	—	—	—	—
*D & P	1. 2. 3. 4. 6. 7. 9. 10. 11. 12.	. . . . .	. . . . .	*D & P	27. 28. 30. 32.	Claret	33.
*D	1. 2. 3. 4. 6. 7. 9. 10. 12.	. . . . .	. . . . .	*D	27. 28. 30.	—	—
. . . . .	. . . . .	*D & P	13. 14. 15. 16. 18. 21. 22. 25. 26.	—	—	—	—
. . . . .	. . . . .	*D	13. 14. 15. 16. 18. 20. 21. 22. 26.	—	—	—	—
*D & P	6. 7. 9. 10. 11. 12.	. . . . .	. . . . .	*D	27. 28. 30.	—	—
		. . . . .	. . . . .	»	»	—	—
	6. 7. 8. 9. 10. 11. 12.	. . . . .	. . . . .	*D & P	27. 28. 30. 32.	Blue	33.
»	»	. . . . .	. . . . .	»		—	—
»	»	. . . . .	. . . . .	»	»	—	—
»	»	. . . . .	. . . . .	»	»	—	—
. . . . .	. . . . .	*D	14. 15. 16. 18. 26.	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
*D & P	6. 7. 9. 10. 11. 12.	*D & P	14. 15. 16. 18. 21. 22. 25. 26.	—	—	—	—
. . . . .	. . . . .	»	14. 15. 16. 18. 21. 22. 24. 25. 26.	—	—	—	—
. . . . .	. . . . .	»	»	—	—	—	—
. . . . .	. . . . .	»	14. 15. 16. 18. 20. 21. 22. 24. 25. 26.	—	—	—	—

*D: for dyeing

*P: » printing.

Brand	Paste or powder	Solubility in water	Shade on a mordant of		
			Alumina	Chrome	Iron
Alizarine Blue SRW powder .	Powder	Soluble in water	. . . .	Dark reddish Blue	. . .
Alizarine Dark Blue WW paste .	Paste	Difficult to dissolve	. . . .		. . .
» » *SW* »	»	Soluble in water	. . . .	»	. . .
» » *SW powder*	Powder		. . . .	»	. . .
Alizarine Indigo Blue S paste .	Paste	»	. . . .	Greenish Blue	. . .
» » *SW paste* .	»		. . . .	»	. . .
» » *SW powder* .	Powder		. . . .	»	. . .
» » *SMW paste*	Paste	»	. . . .	Reddish Blue	. . .
» » *SMW powder*	Powder	»	. . . .	»	. . .
Alizarine Green S paste . . .	Paste	»	. . . .	Bluish Green	. . .
» » *SW paste* . .	»	»	. . . .	»	. . .
» » *SW powder* .	Powder	»	. . . .	»	. . .
Anthracene Blue RR	Paste	Difficult to dissolve	Red Violet	Reddish Blue	. . .
» » *R*	»	»	»	»	. . .
» » *B*	»	»	Reddish Violet	Blue	. . .
» » *G extra* . . .	»	Rather difficult to dissolve	Reddish Blue	»	. . .
» » *G*	»	Slightly soluble	»	Greenish Blue	. . .
» » *GG*	»	»	»	»	. . .
» » *WRR* . . .	»	Difficult to dissolve	Red Violet	Reddish Blue	. . .
» » *WRR extra* .	»	»	»		. . .
» » *WR*	»	»	»	»	. . .
» » *WB*	»	»	Reddish Violet	Blue	. . .
» » *WG extra* . .	»	Rather difficult to dissolve	»	»	. . .
» » *WG*	»	Slightly soluble	Reddish Blue	Greenish Blue	. . .
» » *WGG* . . .	»	»	»	»	. . .

Application

a) Cotton		b) Wool		c) Silk		d) Lake (Alumina)	
Application	Process	Application	Process	Application	Process	Shade	Process
. . . .	. . . . .	*D & P	14. 15. 16. 18. 20. 21. 22. 24. 25. 26.	—	—	—	—
. . . .	. . . . .	*D	14. 15. 16. 18. 26.	—	—	—	—
. . . .	. . . . .	*D & P	14. 15. 16. 18. 21. 22. 25. 26.	—	—	—	—
. . . .	. . . . .	»	14. 15. 16. 18. 20. 21. 22. 25. 26.	—	—	—	—
*D & P	6. 7. 8. 9. 10. 11. 12.	. . . .	. . . .	*D & P	27. 28. 30. 32.	Blue	33.
. . . .	. . . . .	*D & P	14. 15. 16. 18. 21. 22. 24. 25. 26.	—	—	—	—
. . . .	. . . . .	»	14. 15. 16. 18. 20. 21. 22. 24. 25. 26.	—	—	—	—
. . . .	. . . . .	»	14. 15. 16. 18. 21. 22. 24. 25. 26.	—	—	—	—
. . . .	. . . . .	»	14. 15. 16. 18. 20. 21. 22. 24. 25. 26.	—	—	—	—
*D & P	6. 7. 8. 9. 10. 11. 12.	. . . .	. . . .	*D & P	27. 28. 30. 32.	Blue Green	33.
. . . .	. . . . .	*D & P	14. 15. 16. 18. 21. 22. 24. 25. 26.	—	—	—	—
. . . .	. . . . .	»	14. 15. 16. 18. 20. 21. 22. 24. 25. 26.	—	—	—	—
*D & P	1. 2. 3. 4. 6. 7. 9. 10. 11. 12.	. . . .	. . . .	*D & P	27. 28. 30. 32.	Red Violet	33.
»	»	. . . .	. . . . .	»	»	Violet	»
»	»	. . . .	. . . . .	»	»	Blue Violet	»
»	»	. . . .	. . . . .	»	»	Blue	»
»	»	. . . .	. . . . .	»	»	»	»
»	»	. . . .	. . . . .	»	»	»	»
. . . .	. . . . .	*D & P	13. 14. 15. 16. 17. 18. 21. 22. 24. 25. 26.	—	—	—	—
. . . .	. . . . .	»	»	—	—	—	—
. . . .	. . . . .	»	»	—	—	—	—
. . . .	. . . . .	»	»	—	—	—	—
. . . .	. . . . .	»	13. 14. 15. 16. 17. 18. 19. 21. 22. 24. 25. 26.	—	—	—	—
. . . .	. . . . .	»	»	—	—	—	—
. . . .	. . . . .	»	»	—	—	—	—

* **D**: for dyeing

* **P**: » printing.

Brand	Paste or powder	Solubility in water	Shade on a mordant of		
			Alumina	Chrome	Iron
Anthracene Blue WN	Paste	Difficult to dissolve	. . . .	Blue	. . .
» » *SRR* . . .	Powder	Soluble in water	Red Violet	Reddish Blue	. . .
» » *SR*	»	»	»	»	. . .
» » *SB*	»	»	Reddish Violet	Blue	. . .
» » *SG extra* . .	»	»	Reddish Blue	»	. . .
» » *SG*	»	»	»	Greenish Blue	. . .
» » *SGG* . . .	»	»	»	»	. . .
» » *SWRR* . . .	»	»	Red Violet	Reddish Blue	. . .
» » *SWR* . . .	»	»	»	»	. . .
» » *SWB* . . .	»	»	Reddish Violet	Blue	. . .
» » *SWG extra* .	»	»	Reddish Blue	»	. . .
» » *SWG* . . .	»	»	»	Greenish Blue	. . .
» » *SWGG* . .	»	»	»	»	. . .
» » *SWN* . . .	»	»	. . . .	Blue	. . .
» » *SWX* . . .	»	»	. . . .	Reddish Blue	. . .
» » *SWX extra* .	»	»	. . . .	»	. . .
Anthracene Dark Blue W . .	Paste	Difficult to dissolve	. . . .	Dark reddish Blue	. . .
» » » *SW* . .	Powder	Soluble in water	. . . .	»	. . .
Anthracene Brown	Paste 20 %, 40 %	Difficult to dissolve	Reddish Brown	Reddish Brown	Dark Brown
» » *W*	» 20 %, 40 %	»	»	»	. . .
» » *WR* . . .	» 20 %, 40 %	»	»	»	. . .
» » *WG* . . .	Paste 20 %	»	Yellowish Brown	Yellowish Brown	. . .
» » *WGG* . .	» 20 %	»	»	»	. . .
» » *SW* . . .	Powder	Soluble in water	Reddish Brown	Reddish Brown	. . .
» » *SWR* . .	»	»	»	»	. . .

Application

a) Cotton		b) Wool		c) Silk		d) Lake (Alumina)	
Application	Process	Application	Process	Application	Process	Shade	Process
. . . .	. . . .	*D & P	13. 14. 15. 16. 17. 18. 21. 22. 24. 25. 26.	—	—	—	—
*D	1. 2. 3. 4. 6. 7. 9. 10. 11. 12.	. . . .	. . . .	*D	27. 28. 30.	—	—
»	»	. . . .	. . . .	»	»	—	—
»	»	. . . .	. . . .	»	»	—	—
»	»	. . . .	. . . .	»	»	—	—
»	»	. . . .	. . . .	»	»	—	—
»	»	. . . .	. . . .	»	»	—	—
. . . .	. . . .	*D & P	13. 14. 15. 16. 17. 18. 20. 21. 22. 24. 25. 26.	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	*D	19.	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	*D & P	14. 15. 16. 17. 21. 22. 25. 26.	*D	28. 30.	—	—
. . . .	. . . .	»	14. 15. 16. 17. 20. 21. 22. 25. 26.	»	28. 30.	—	—
*D & P	1. 2. 3. 4. 5. 6. 7. 9. 10. 11. 12.	. . . .	. . . .	*D & P	27. 28. 30. 32.	Brown	33.
. . . .	. . . .	*D & P	14. 15. 16. 18. 21. 22. 25. 26.	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—
. . . .	. . . .	»	14. 15. 16. 18. 20. 21. 22. 25. 26.	—	—	—	—
. . . .	. . . .	»	»	—	—	—	—

* D: for dyeing
* P: » printing.

Brand	Paste or powder	Solubility in water	Shade on a mordant of		
			Alumina	Chrome	Iron
Galleïne	Paste	Fairly soluble	. . . .	Violet	. . .
» *W paste*	»	»	. . . .	»	. . .
» *W powder*	Powder	»	. . . .	»	. . .
» *WR*	Paste	»	. . . .	»	. . .
» *S W*	Powder	Soluble in water	. . . .	»	. . .
Coeruleïne II	Paste	Difficult to dissolve	Green	Olive Green	. . .
» *I*	»	»	»	»	. . .
» *W*	»	»	. . . .	»	. . .
» *S paste*	»	Soluble in water	Green	»	. . .
» *S W paste*	»	»	. . . .	»	. . .
» *S powder*	Powder	»	Green	»	. . .
» *S W powder*	»	»	. . . .	»	. . .
Galloflavine	Paste	Fairly soluble	. . . .	Yellow	. . .
» *W paste*	»	»	. . . .	»	. . .
» *W powder*	Powder	»	. . . .	»	. . .
Alizarine Black R paste	Paste	»	. . . .	Black	. . .
» » *S* »	»	Soluble in water	. . . .	»	. . .
» » *SR* »	»	»	. . . .	»	. . .
» » *SRA paste*	»	»	. . . .	Blue Black	. . .
» » *WR* »	»	Fairly soluble	. . . .	Black	. . .
» » *SW* »	»	»	. . . .	Bluish Black	. . .
» » *SRW* »	»	»	. . . .	Black	. . .
» » *R powder*	Powder	»	. . . .	»	. . .
» » *WR* »	»	»	. . . .	»	. . .
» » *SW* »	»	»	. . . .	Bluish Black	. . .

Application

a) Cotton		b) Wool		c) Silk		d) Lake (Alumina)	
pplication	Process	Application	Process	Application	Process	Shade	Process
D & P	6. 7. 9. 10. 11. 12.	. . . .	. . . .	*D & P	27. 28. 30. 32.	Violet	33.
. . .	. . . .	*D & P	14. 15. 16. 18. 21. 22. 25. 26.	—	—	—	—
. . .	. . . .	*D	14. 15. 16. 18. 20. 21. 22. 26.	—	—	—	—
. . .	. . . .	»	14. 15. 16. 18. 21. 22. 26.	—	—	—	—
. . . .	. . . .	»	14. 15. 16. 18. 20. 21. 22. 26.	—	—	—	—
*D & P	1. 2. 3. 4. 6. 7. 9. 10. 11. 12.	. . . .	. . . .	. . . .	. . . .	Green	33.
»	»	—	—	—	—	—	—
. . . .	. . . .	*D	14. 15. 16. 17. 18. 21. 22. 26.	—	—	—	—
*D & P	1. 2. 3. 4. 6. 7. 8. 9. 10. 11. 12.	. . . .	. . . .	*D & P	27. 28. 30. 32.	—	—
. . . .	. . . .	*D & P	14. 15. 16. 17. 18. 21. 22. 25. 26.	—	—	—	—
*D & P	1. 2. 3. 4. 6. 7. 8. 9. 10. 11. 12.	. . . .	. . . .	*D & P	27. 28. 30. 32.	—	—
. . . .	. . . .	*D & P	14. 15. 16. 17. 18. 20. 21. 22. 25. 26.	—	—	—	—
*D & P	6. 7. 9. 10. 11. 12.	. . . .	. . . .	*D & P	28. 30. 32.	Yellow	33.
. . . .	. . . .	*D & P	14. 15. 16. 18. 21. 22. 25. 26.	—	—	—	—
. . . .	. . . .	*D	14. 15. 16. 18. 20. 21. 22. 26.	—	—	—	—
*D	6. 7.	. . . .	. . . .	*D	28. 29. 30. 31.	Blue Black	33.
*P	8. 11. 12.	*P	25.	*P	32.	—	—
»	»	»	»	»	»	—	—
»	»	—	—	—	—	—	—
. . . .	. . . .	*D	14. 15. 16. 17. 19. 21. 22. 26.	—	—	—	—
. . . .	. . . .	»	14. 15. 16. 21. 22. 26.	*D	28. 29. 30. 31.	Blue Black	—
. . . .	. . . .	»	»	»	»	»	—
*D	6. 7.	. . . .	. . . .	»	»	—	—
. . . .	. . . .	*D	14. 15. 16. 17. 19. 20. 21. 22. 26.	—	—	—	—
. . . .	. . . .	»	14. 15. 16. 20. 21. 22. 26.	*D	28. 29. 30. 31.	Blue Black	—

* D: for dyeing
* P: » printing.

Brand	Paste or powder	Solubility in water	Shade on a mordant of		
			Alumina	Chrome	Iron
Alizarine Black SRW powder	Powder	Fairly soluble	. . . .	Black	. . .
Alizarine Blue Black SW paste	Paste	»	. . . .	Blue Black	. . .
» » » *W* »	»	»	. . . .	»	. . .
» » » *SW powder*	Powder	»	. . . .	»	. . .
» » » *W* »	»	»	. . . .	»	. . .
Alizarine Yellow A paste	Paste 20 %	»	Reddish Yellow	. . . .	. . .
» » *C* »	» 20 %	»	Lemon Yellow	. . . .	. . .
» » *A powder*	Powder	»	Reddish Yellow	. . . .	. . .
» » *C* »	»	»	Lemon Yellow	. . . .	. . .
Wool Yellow	Paste	Difficult to dissolve	. . . .	Reddish Yellow	. . .
Mordant Yellow G	Powder	Soluble in water	. . . .	Yellow	. . .
» » *R*	»	»	. . . .	Reddish Yellow	. . .
Fast Mordant Yellow G	»	»	. . . .	»	. . .
Carbazole Yellow W	»	»	. . . .	Yellow	. . .
Appendix.					
Fast Black B paste	Paste	Difficult to dissolve	. . . .	. . . .	. . .
» » *B powder*	Powder	»	. . . .	. . . .	. . .
» » *BS*	Paste	Soluble in water	. . . .	. . . .	. . .
Indophor	Powder	Difficult to dissolve	. . . .	. . . .	. . .

Application

a) Cotton		b) Wool		c) Silk		d) Lake (Alumina)	
Application	Process	Application	Process	Application	Process	Shade	Process
. . . . .	. . . . .	*D	14. 15. 16. 20. 21. 22. 26.	*D	28. 29. 30. 31.	—	—
. . . . .	. . . . .	»	14. 15. 16. 17. 21. 22. 26.	»	»	—	—
. . . . .	. . . . .	»	»	»	»	—	—
. . . . .	. . . . .	»	14. 15. 16. 17. 20. 21. 22. 26.	»	»	—	—
. . . . .	. . . . .	»	»	—	—	—	—
*D & P	1. 2. 3. 4. 9. 10. 11. 12.	—	—	—	—	—	—
»	»	—	—	—	—	—	—
»	»	—	—	—	—	—	—
»	»	—	—	—	—	—	—
. . . . .	. . . . .	*D	14. 15. 16. 17. 18. 21. 22. 26.	—	—	—	—
*D & P	6. 7. 9. 10. 11. 12.	*D & P	14. 15. 16. 17. 18. 19. 20. 21. 22. 25. 26.	*D & P	28. 30. 32.	—	—
»	»	»	»	»	»	—	—
»	»	»	»	»	»	—	—
»	6. 7. 11.	»	»	»	»	—	—
*D	36.	—	—	—	—	—	—
»	»	—	—	—	—	—	—
»	»	—	—	—	—	—	—
*P	37.	—	—	—	—	—	—

*D: for dyeing

*P: » printing.

M.

Proportionate Colouring Strength

of the

Alizarine powder and Alizarine paste brands.

	Powder			Paste
1 part	*Alizarine Red SWB, SWR, SWG*	= *about*	*4 parts*	*Alizarine Red 20 %*
1 »	» » *S, SS, SSS*	=	» *3* »	» » *20 %*
1 »	*Alizarine Orange SW*	=	» $5^{1}/_{3}$ »	*Alizarine Orange W 15 %*
1 »	*Alizarine Maroon*	=	» *10* »	*Alizarine Maroon (10 %)*
1 »	*Alizarine Blue S, SW, SRW*	=	» *3* »	*Alizarine Blue S, SW, SRW*
1 »	*Alizarine Dark Blue SW*	=	» *4* »	*Alizarine Dark Blue SW*
1 »	*Alizarine Indigo Blue S, SW, SMW*	=	» *5* »	*Alizarine Indigo Blue S, SW, SMW*
1 »	*Alizarine Green S, SW*	=	» *5* »	*Alizarine Green S, SW*
1 »	*Anthracene Blue SRR, SWRR*	=	» *8* »	*Anthracene Blue RR, WRR*
1 »	» » *SR, SWR*	=	» *8* »	» » *R, WR*
1 »	» » *SB, SWB*	=	» *8* »	» » *B, WB*
1 »	» » *SG extra, SWG extra*	=	» *8* »	» » *G extra, WG extra*
1 »	» » *SGG, SWGG*	=	» *8* »	» » *GG, WGG*
1 »	» » *SG, SWG*	=	» *8* »	» » *G, WG*
1 »	» » *SWN*	=	» $5^{1}/_{3}$ »	» » *WN*
1 »	*Anthracene Dark Blue SW*	=	» *4* »	*Anthracene Dark Blue W*
1 »	*Anthracene Brown SW*	=	» *4* »	*Anthracene Brown W*
1 »	*Galleïne*	=	» *10* »	*Galleïne (10 %)*
1 »	» *SW*	=	» *8* »	» *W (10 %)*
1 »	*Coeruleïne S, SW*	=	» *4* »	*Coeruleïne S, SW*
1 »	*Galloflavine W*	=	» *10* »	*Galloflavine W*
1 »	*Alizarine Black R, WR*	=	» *6* »	*Alizarine Black R, WR*
1 »	» » *SW, SRW*	=	» *5* »	» » *SW, SRW*
1 »	*Alizarine Blue Black SW*	=	» *5* »	*Alizarine Blue Black SW*
1 »	» » » *W*	=	» *6* »	» » » *W*
1 »	*Fast Black B*	=	» *4* »	*Fast Black B.*

N.

Notes

about

Weights and Measures, Specific Gravity and Temperatures.

IN this book the specific gravity has been expressed by degrees Twaddell, and the temperature by Fahrenheit. The following comparative tables shewing the relation to some other systems will in many cases prove interesting and useful.

I. Measures.

a) Measures of length.

Metrical system:

1 metre = 10 decimetres = 100 centimetres = 1000 millimetres.

English measure:

1 yard = 3 feet = 0·9144 metres.
1 inch = about 25·4 millimetres.

Russian measure:

1 arschin = 0·7112 metres.

b) Superficial measures.

Metrical system:

1 square metre = 100 square decimetres = 10,000 square centimetres = 1,000,000 square millimetres.

English measure:

1 square yard = 9 square feet = 0·836 square metres.

c) Measures of capacity.

Metrical system:

1 cubic metre = 1000 cubic decimetres (= 1000 litres).
1 cubic decimetre = 1 litre = 1000 cubic centimetres.

English measure:

1 cubic yard = 27 cubic feet = 0·7645 cubic metres.
1 gallon = 2 pottles = 4 quarts = 8 pints = 32 gills = 4·5436 litres.

II. Weights.

Metrical system:

1 Kilogramme (Kilos) = 10 hectogrammes (hg.) = 100 decagrammes (dg.) = 1000 grammes (gr.).
1 ℔ = $^{1}/_{2}$ Kilo.

English weights:

1 pound (lb.) = 16 ounces (oz) = 453·6 grammes.
1 hundredweight (cwt.) = 112 lbs. = 50·8 Kilos.
1 ton = 20 cwts.

Russian weights:

1 pound = 96 solotnik = 409·5 grammes.
1 pud = 40 pounds = 16·38 Kilos.

III. Specific gravity.

Comparison of degrees Twaddell with degrees Beaumé.

Tw.	Bé	Tw.	Bé	Tw.	Bé	Tw.	Bé	Tw.	Bé
0	0	35	21·4	70	37·4	105	49·7	140	59·5
1	0·7	36	22·0	71	37·8	106	50·0	141	59·7
2	1·4	37	22·5	72	38·2	107	50·3	142	60·0
3	2·1	38	23·0	73	38·6	108	50·6	143	60·2
4	2·7	39	23·5	74	39·0	109	50·9	144	60·4
5	3·4	40	24·0	75	39·4	110	51·2	145	60·6
6	4·1	41	24·5	76	39·8	111	51·5	146	60·9
7	4·7	42	25·0	77	40·1	112	51·8	147	61·1
8	5·4	43	25·5	78	40·5	113	52·1	148	61·4
9	6·0	44	26·0	79	40·8	114	52·4	149	61·6
10	6·7	45	26·4	80	41·2	115	52·7	150	61·8
11	7·4	46	26·9	81	41·6	116	53·0	151	62·1
12	8·0	47	27·4	82	42·0	117	53·3	152	62·3
13	8·7	48	27·9	83	42·3	118	53·6	153	62·5
14	9·4	49	28·4	84	42·7	119	53·9	154	62·8
15	10·0	50	28·8	85	43·1	120	54·1	155	63·0
16	10·6	51	29·3	86	43·4	121	54·4	156	63·2
17	11·2	52	29·7	87	43·8	122	54·7	157	63·5
18	11·9	53	30·2	88	44·1	123	55·0	158	63·7
19	12·4	54	30·6	89	44·4	124	55·2	159	64·0
20	13·0	55	31·1	90	44·8	125	55·5	160	64·2
21	13·6	56	31·5	91	45·1	126	55·8	161	64·4
22	14·2	57	32·0	92	45·4	127	56·0	162	64·6
23	14·9	58	32·4	93	45·8	128	56·3	163	64·8
24	15·4	59	32·8	94	46·1	129	56·6	164	65·0
25	16·0	60	33·3	95	46·4	130	56·9	165	65·2
26	16·5	61	33·7	96	46·8	131	57·1	166	65·5
27	17·1	62	34·2	97	47·1	132	57·4	167	65·7
28	17·7	63	34·6	98	47·4	133	57·7	168	65·9
29	18·3	64	35·0	99	47·8	134	57·9	169	66·1
30	18·8	65	35·4	100	48·1	135	58·2	170	66·3
31	19·3	66	35·8	101	48·4	136	58·4	171	66·5
32	19·8	67	36·2	102	48·7	137	58·7	172	66·7
33	20·3	68	36·6	103	49·0	138	58·9	173	67·0
34	20·9	69	37·0	104	49·4	139	59·2		

IV. Temperature.

Comparison of the Centigrade thermometer with those of Réaumur and Fahrenheit.

Centigrade	Réaumur	Fahrenheit	Centigrade	Réaumur	Fahrenheit	Centigrade	Réaumur	Fahrenheit
+ 100	+ 80	+ 212	+ 65	+ 52	+ 149	+ 30	+ 24	+ 86
99	79·2	210·2	64	51·2	147·2	29	23·2	84·2
98	78·4	208·4	63	50·4	145·4	28	22·4	82·4
97	77·6	206·6	62	49·6	143·6	27	21·6	80·6
96	76·8	204·8	61	48·8	141·8	26	20·8	78·8
95	76	203	60	48	140	25	20	77
94	75·2	201·2	59	47·2	138·2	24	19·2	75·2
93	74·4	199·4	58	46·4	136·4	23	18·4	73·4
92	73·6	197·6	57	45·6	134·6	22	17·6	71·6
91	72·8	195·8	56	44·8	132·8	21	16·8	69·8
90	72	194	55	44	131	20	16	68
89	71·2	192·2	54	43·2	129·2	19	15·2	66·2
88	70·4	190·4	53	42·4	127·4	18	14·4	64·4
87	69·6	188·6	52	41·6	125·6	17	13·6	62·6
86	68·8	186·8	51	40·8	123·8	16	12·8	60·8
85	68	185	50	40	122	15	12	59
84	67·2	183·2	49	39·2	120·2	14	11·2	57·2
83	66·4	181·4	48	38·4	118·4	13	10·4	55·4
82	65·6	179·6	47	37·6	116·6	12	9·6	53·6
81	64·8	177·8	46	36·8	114·8	11	8·8	51·8
80	64	176	45	36	113	10	8	50
79	63·2	174·2	44	35·2	111·2	9	7·2	48·2
78	62·4	172·4	43	34·4	109·3	8	6·4	46·4
77	61·6	170·6	42	33·6	107·6	7	5·6	44·6
76	60·8	168·8	41	32·8	105·8	6	4·8	42·8
75	60	167	40	32	104	5	4	42
74	59·2	165·2	39	31·2	102·2	4	3·2	39·2
73	58·4	163·4	38	30·4	100·4	3	2·4	37·4
72	57·6	161·6	37	29·6	98·6	2	1·6	35·6
71	56·8	159·8	36	28·8	96·8	1	0·8	33·8
70	56	158	35	28	95	0	0	32
69	55·2	156·2	34	27·2	93·2	— 1	— 0·8	30·2
68	54·4	154·4	33	26·4	91·4	2	1·6	28·4
67	53·6	152·6	32	25·6	89·6	3	2·4	26·6
66	52·8	150·8	31	24·8	87·8	4	3·2	24·8

Centigrade	Réaumur	Fahrenheit	Centigrade	Réaumur	Fahrenheit	Centigrade	Réaumur	Fahrenheit
— 5	— 4	+ 23	— 17	— 13·6	+ 1·4	— 29	— 23·2	— 20·2
6	4·8	21·2	18	14·4	— 0·4	30	24	22
7	5·6	19·4	19	15·2	2·2	31	24·8	23·8
8	6·4	17·6	20	16	4	32	25·6	25·6
9	7·2	15·8	21	16·8	5·8	33	26·4	27·4
10	8	14	22	17·6	7·6	34	27·2	29·2
11	8·8	12·2	23	18·4	9·4	35	28	31
12	9·6	10·4	24	19·2	11·2	36	28·8	32·8
13	10·4	8·6	25	20	13	37	29·6	34·6
14	11·2	6·8	26	20·8	14·8	38	30·4	36·4
15	12	5	27	21·6	16·6	39	31·2	38·2
16	12·8	3·2	28	22·4	18·4	40	32	40

O.

Sketches of Apparatuses, etc.

Table 1. Boiling out-vat for cotton yarn, etc.
» 2. Vat for oiling, mordanting, chalking, etc.
» 3. Washing-vat.
» 4. Dye-vat for yarn heated by direct steam.
» 5. » » » » » » steam coil.
» 6. Steaming Apparatus.
» 7. Steaming Apparatus.
» 8. Brightening (steaming) Apparatus for cotton yarn.
» 9. Boiler for wool-dyeing fitted with a steam jacket (33 gall.).
» 10. » » » » » » » » » (440 »).
» 11. » » » » heated by direct fire (440 gall.).
» 12. Dye-vat for piece-goods.
» 13. Dyeing Machine Obermaier & Co., Lambrecht.
» 14. » » Schmidt, Langensalza.
» 15. » » Schulze, Schmölln.
» 16. » » H. Schirp, Barmen-Rittershausen.
» 17. » » Drèze-Michaelis, Verviers-Cottbus.
» 18. » » Skène & Devallée, Roubaix.
» 19. » » Harmel frères, Val-des-Bois.
» 20. Yarn-dyeing Machine The Klauder-Weldon Dyeing Machine Company, Huddersfield.
» 21. Model of Slubbing-printing Machine (System Vigoureux).
» 22. Iron Jigger.
» 23. Dyeing Machine for cotton warp.

Boiling out-vat
for cotton yarn, etc.

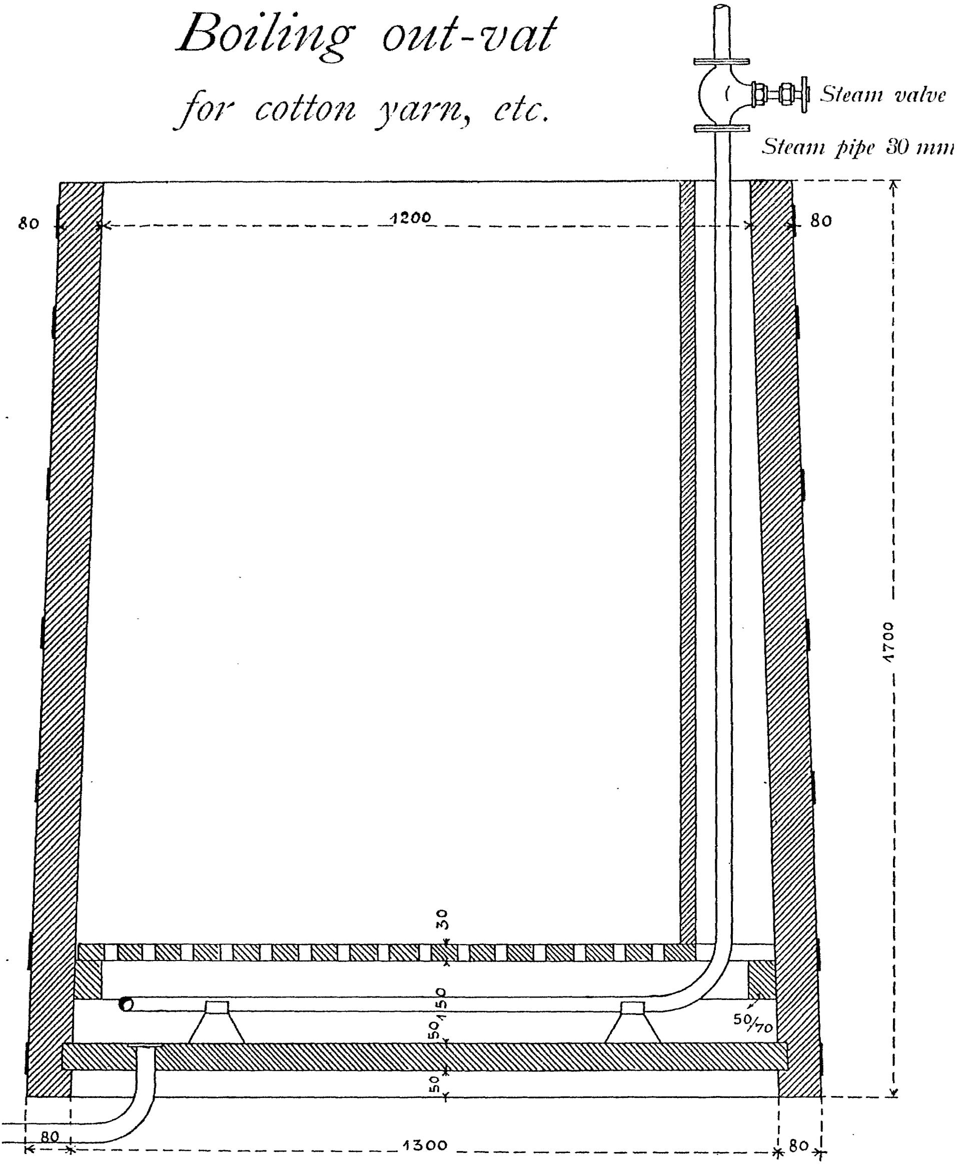
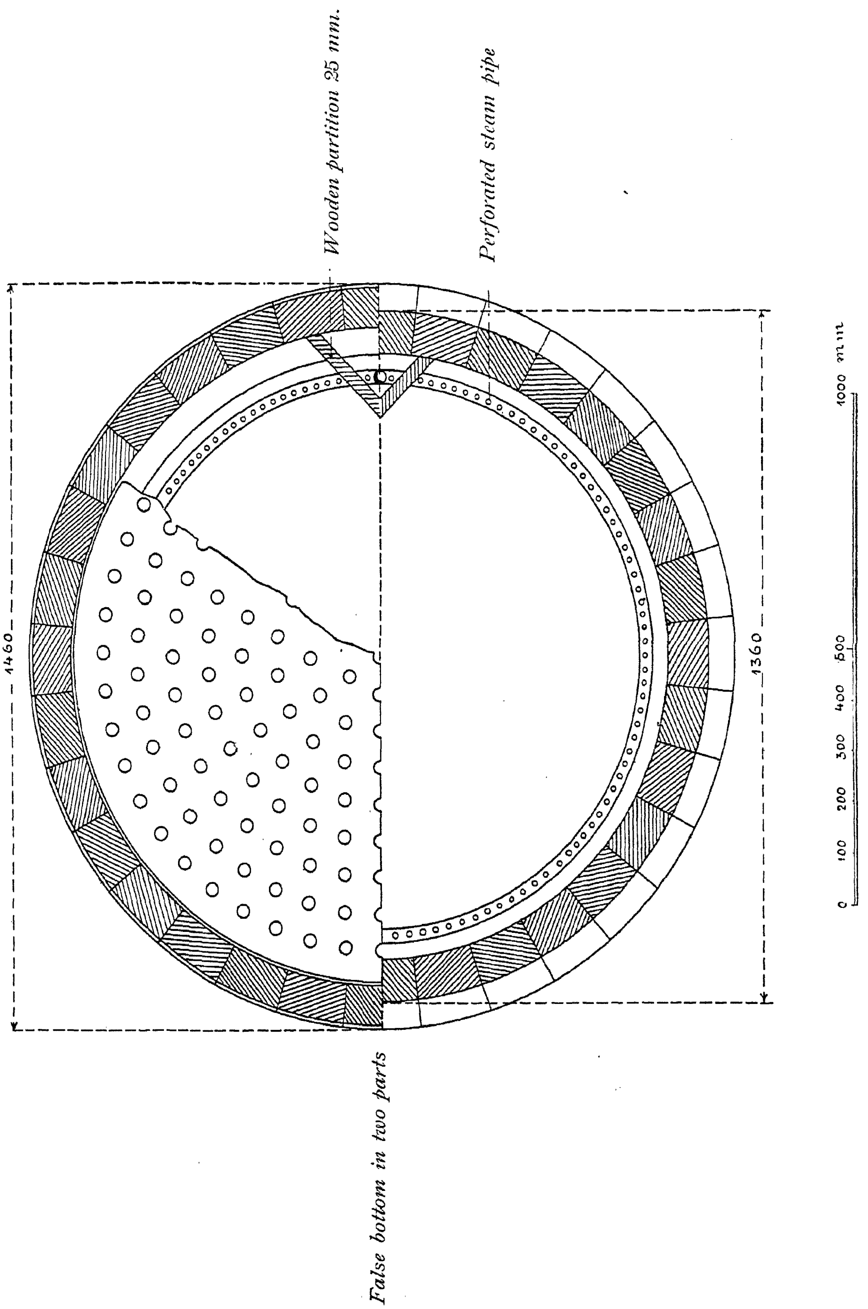
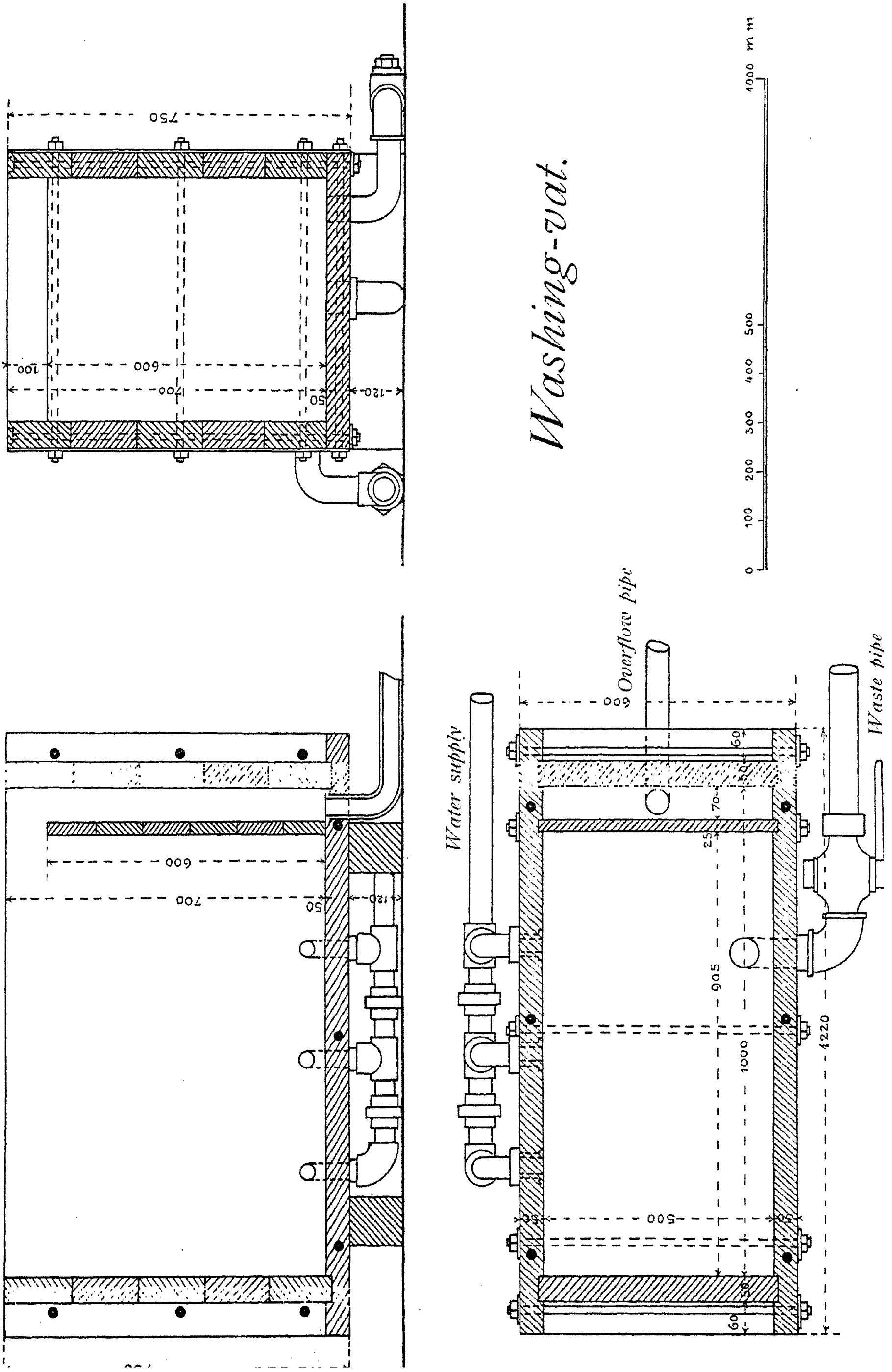


Table 1.


Wooden partition 25 mm.
Perforated steam pipe
False bottom in two parts
1000 mm



Washing-vat.

Overflow pipe
Waste pipe
Water supply
1000 mm

Dye-vat for yarn

heated by direct steam.

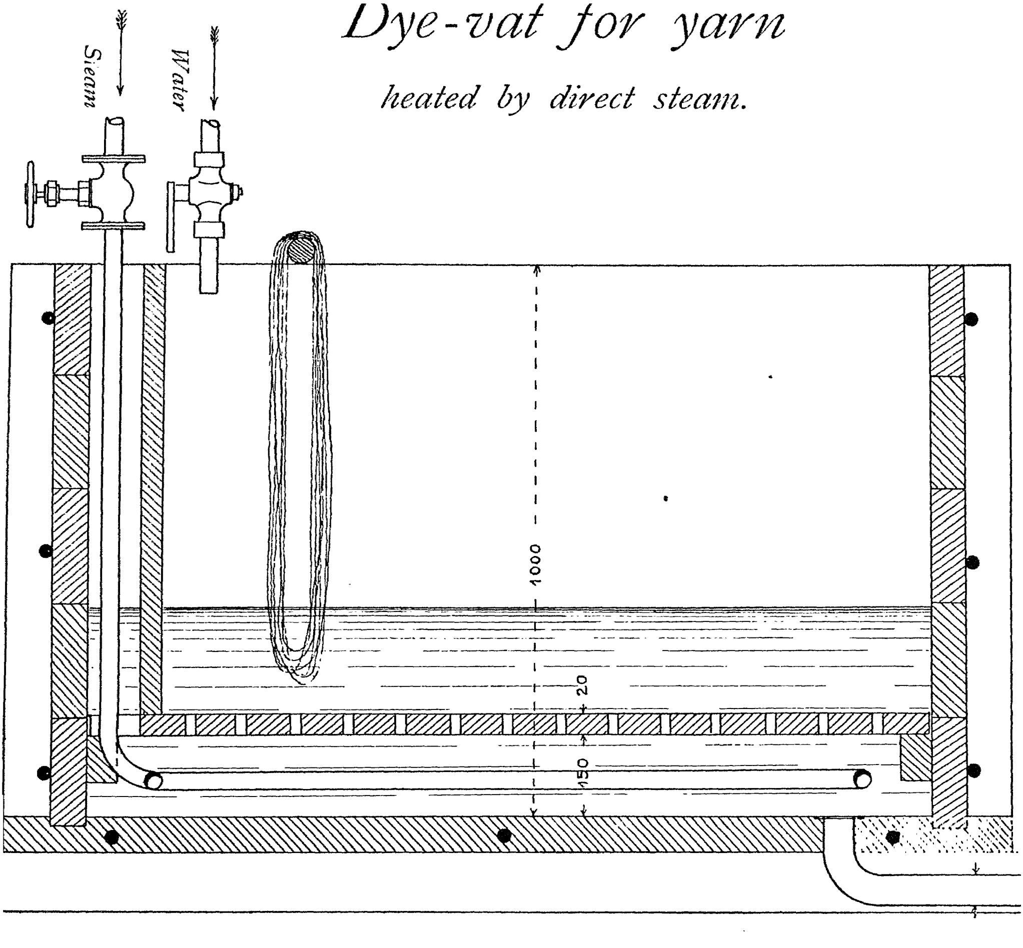


Table 4.

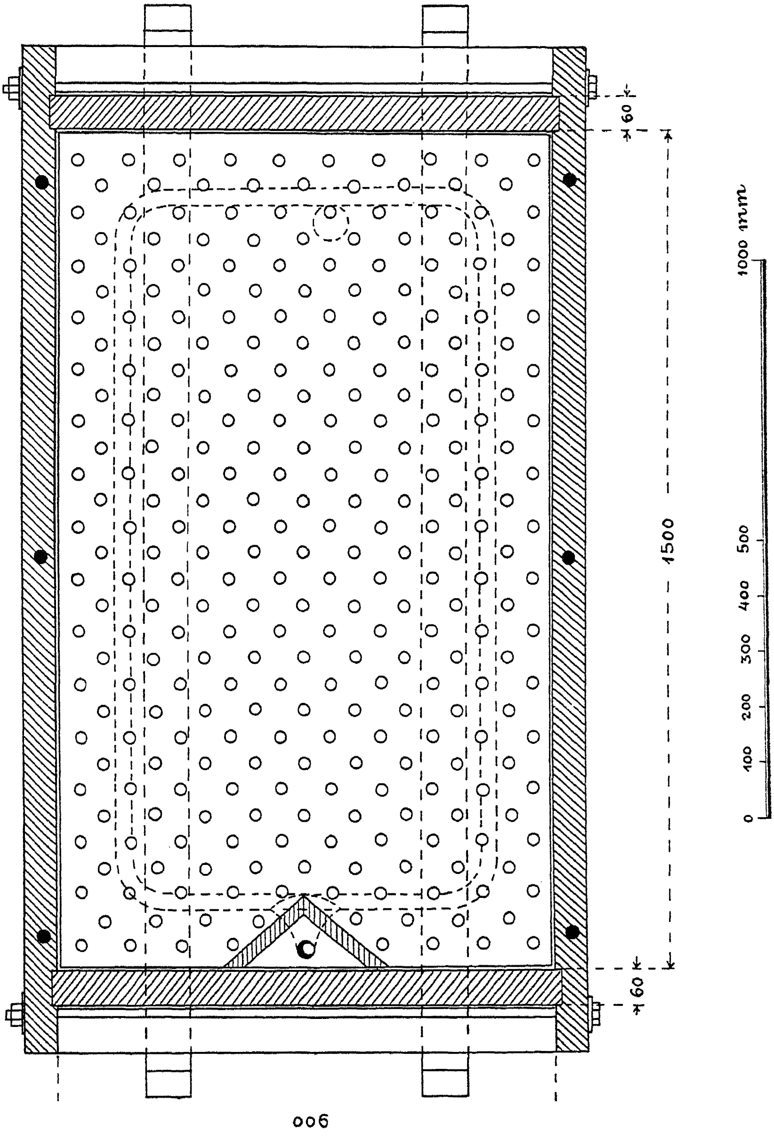
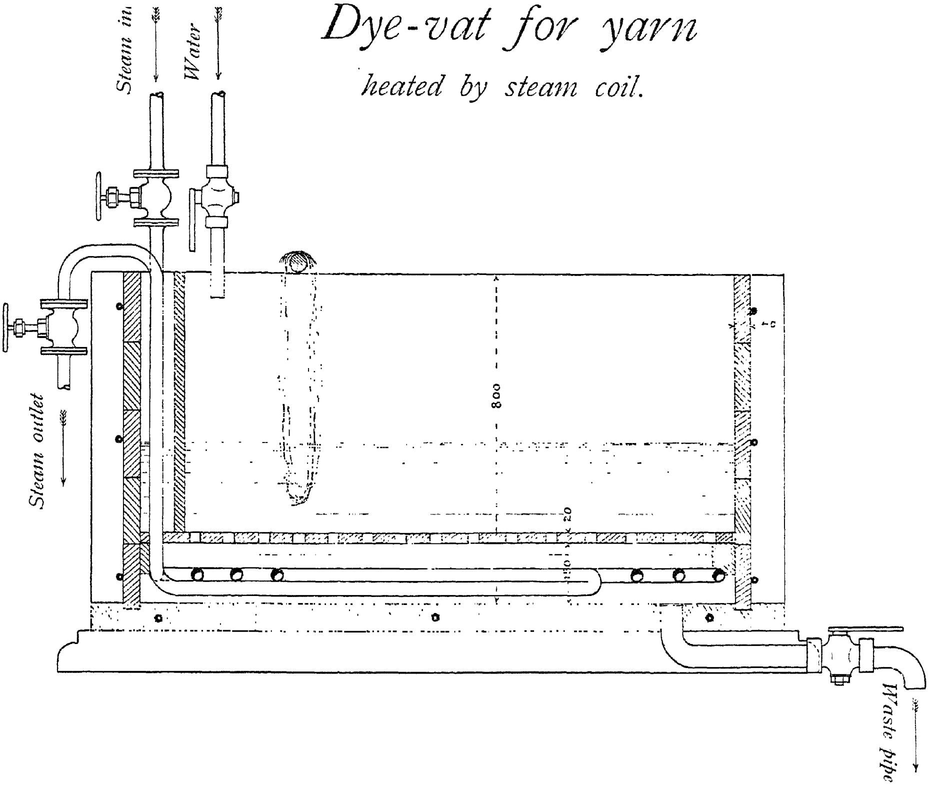
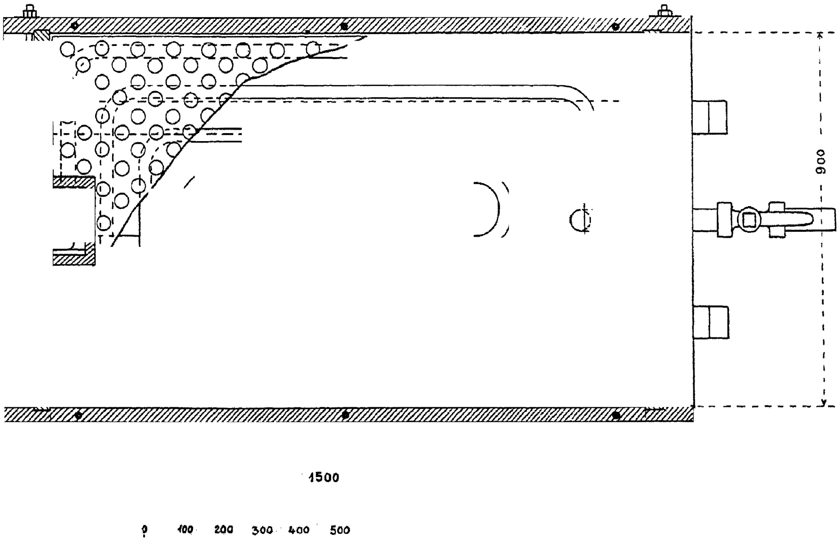


Table 5.

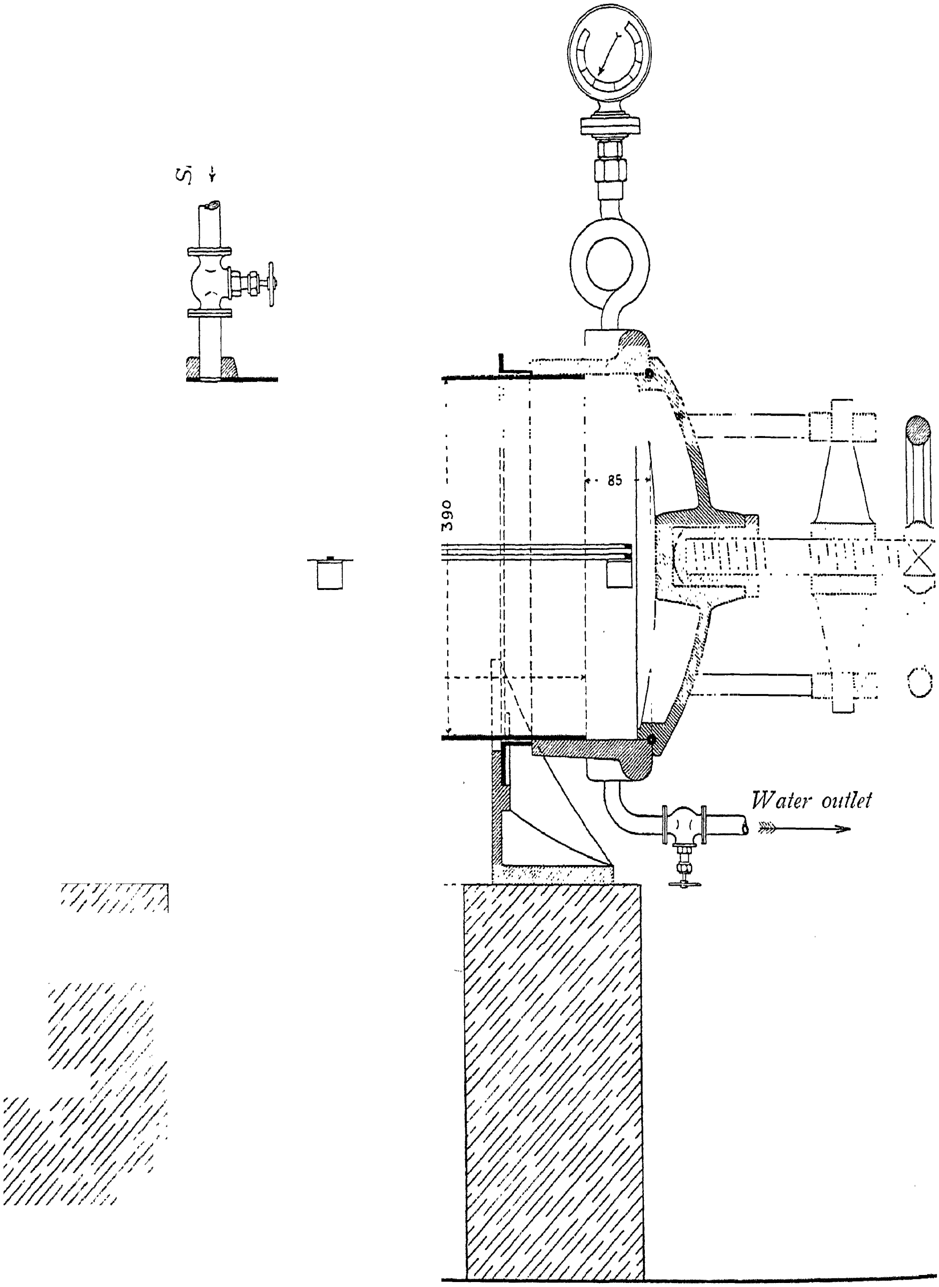
Dye-vat for yarn

heated by steam coil.



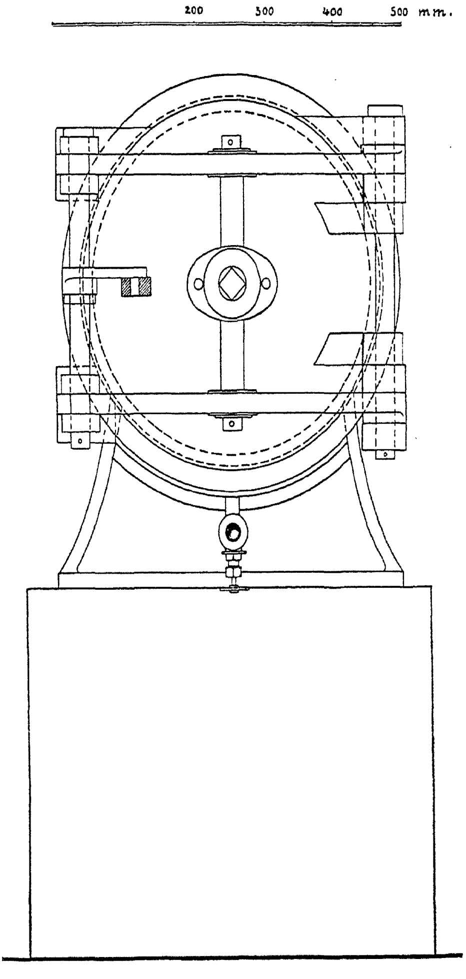


Steaming Apparatus.

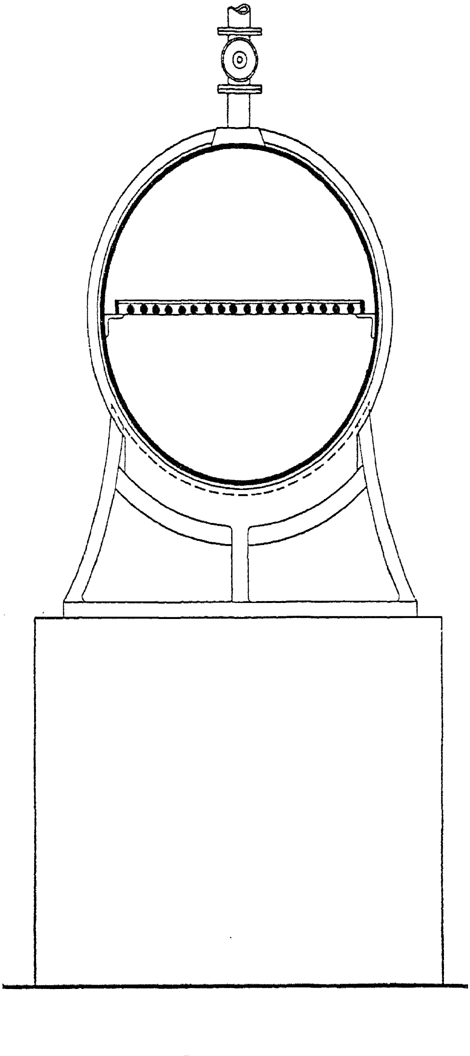


Vertical section

Table 6.



End view



Cross section

Table 7.

Steaming Apparatus.

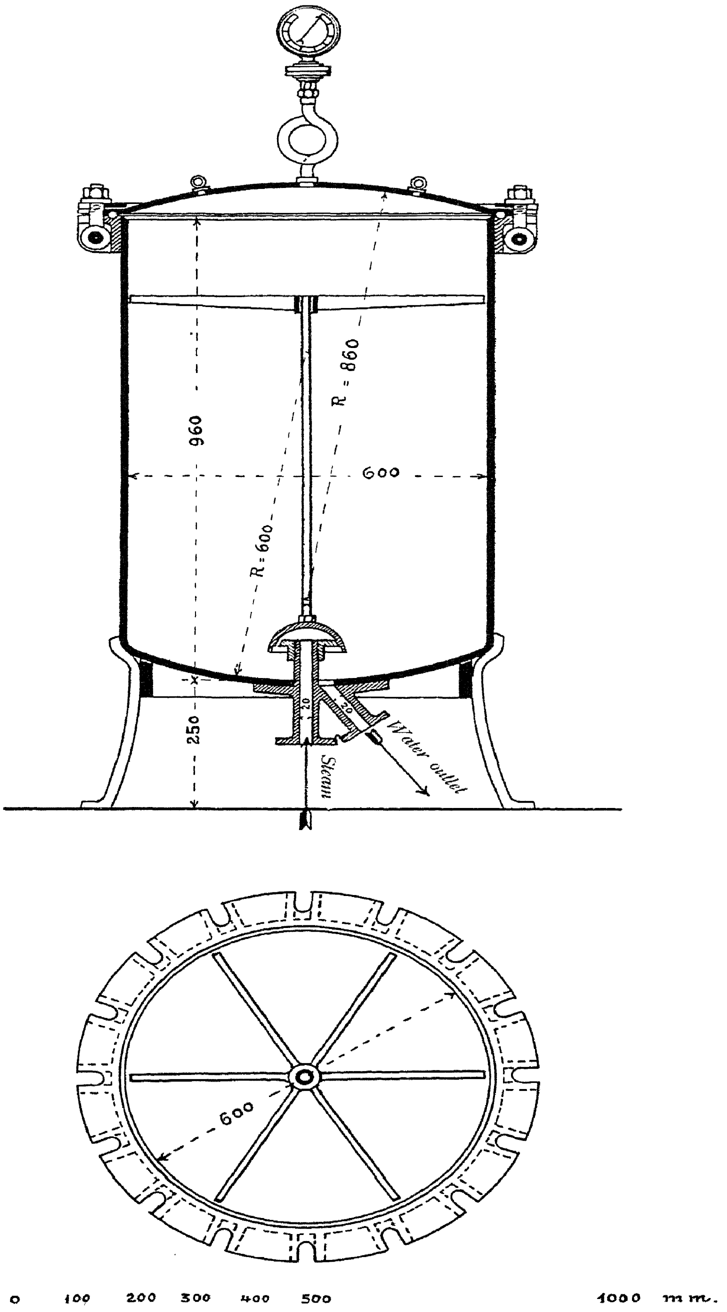


Table 8.

Brightening (steaming) Apparatus for cotton yarn.

- *a) Tinned copper basket for the yarn*
- *b) Tinned copper lid with clasp c*
- *d) Steam chamber for direct steam at 2 atm.*
- *e) Steam chamber for indirect steam up to 5 atm.*
- *f) Inlet for direct steam*
- *g) Outlet for condensed water from the same (f)*
- *h) Inlet for indirect heating steam*
- *i) Outlet for condensed water from the same (h)*
- *k) Lid (with bolts l) hinged at m*
- *n) Manometer*
- *o) Safety valve for 2 atm.*
- *p) Outlet for steam pressure*
- *q) Iron stand.*

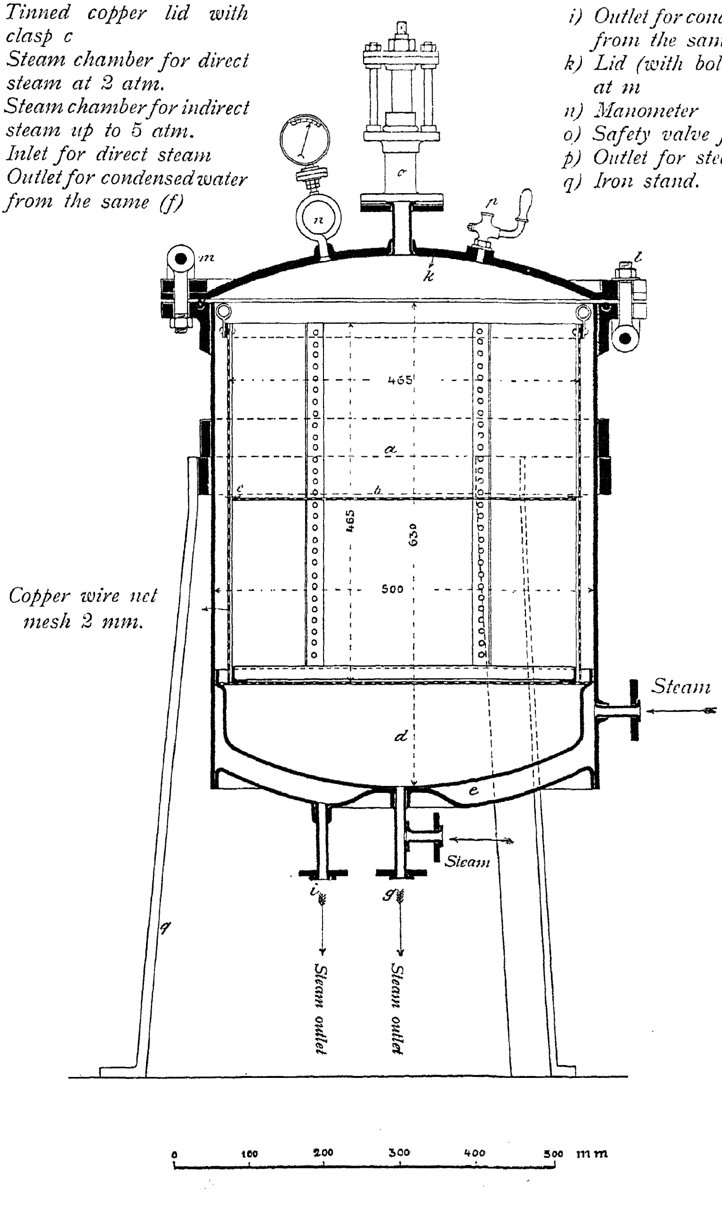


Table 9.

Boiler for wool-dyeing fitted with a steam jacket.

Contents = 33 gallons.

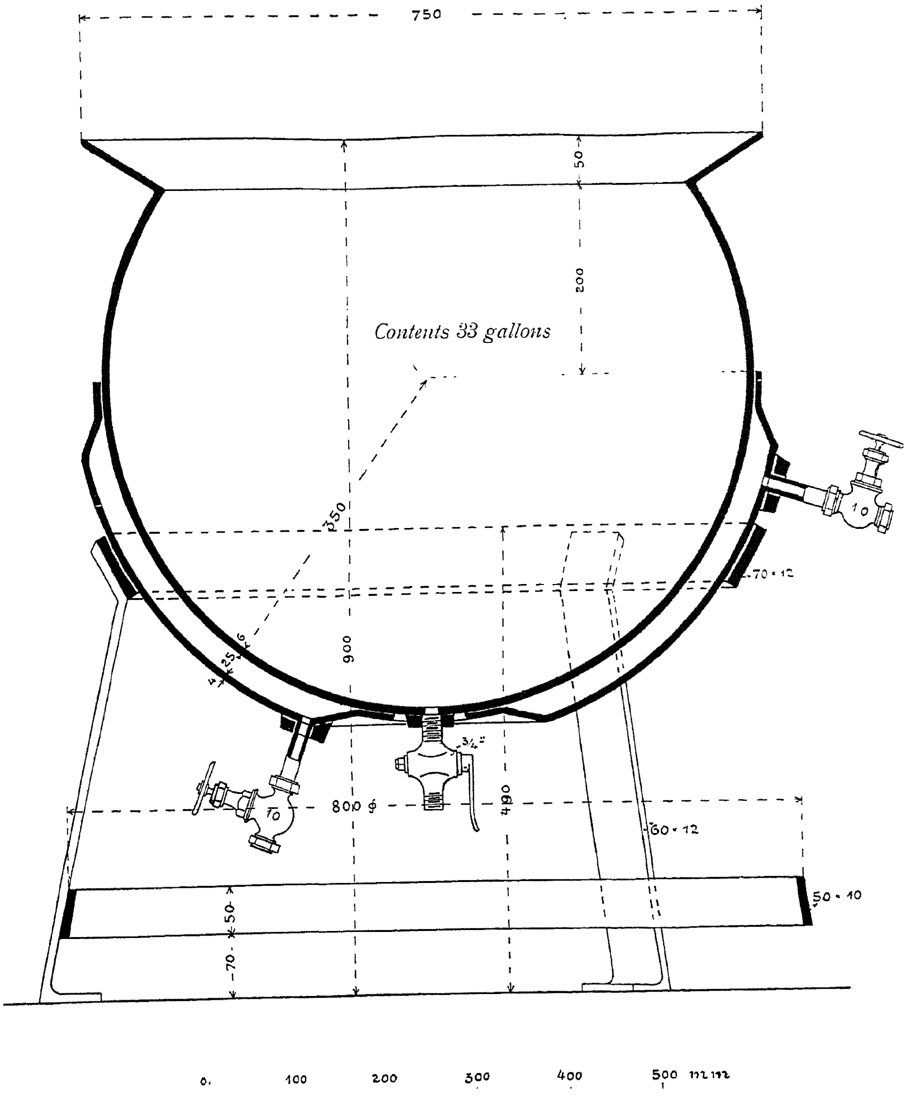


Table 10.

Boiler for wool-dyeing fitted with a steam jacket.

Contents = 440 gallons.

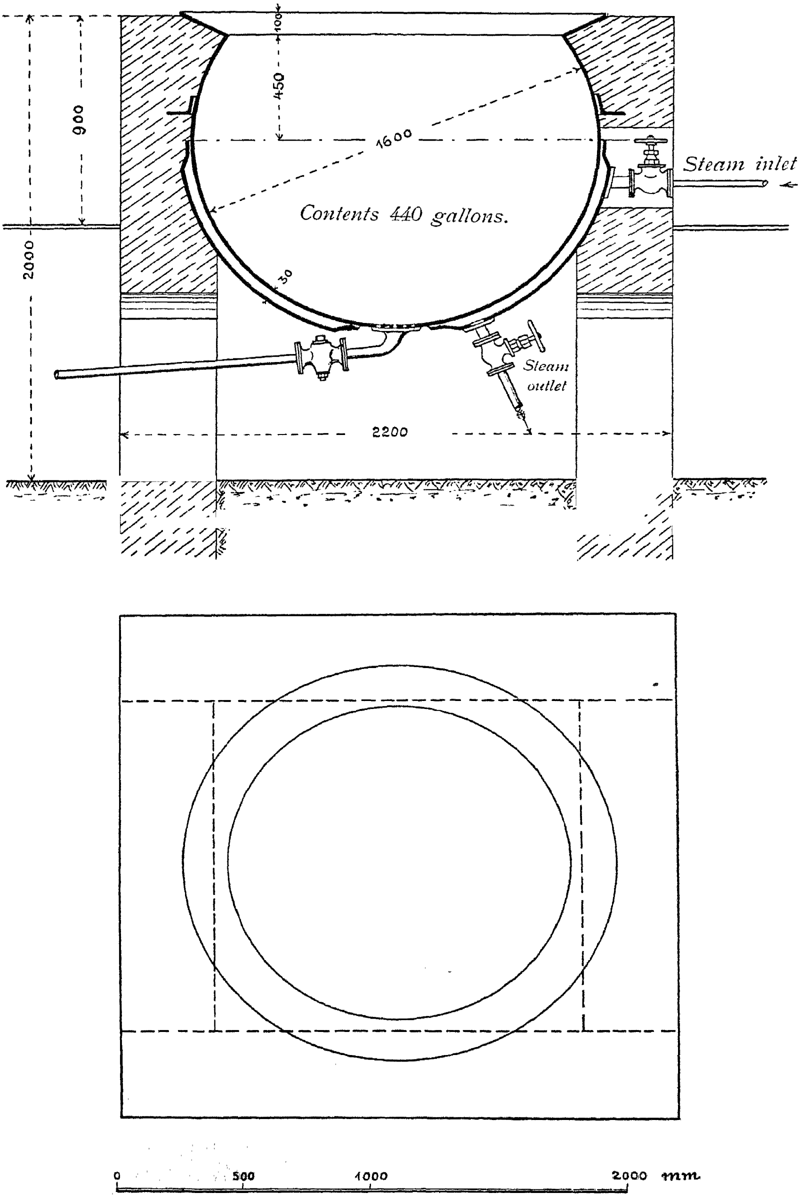
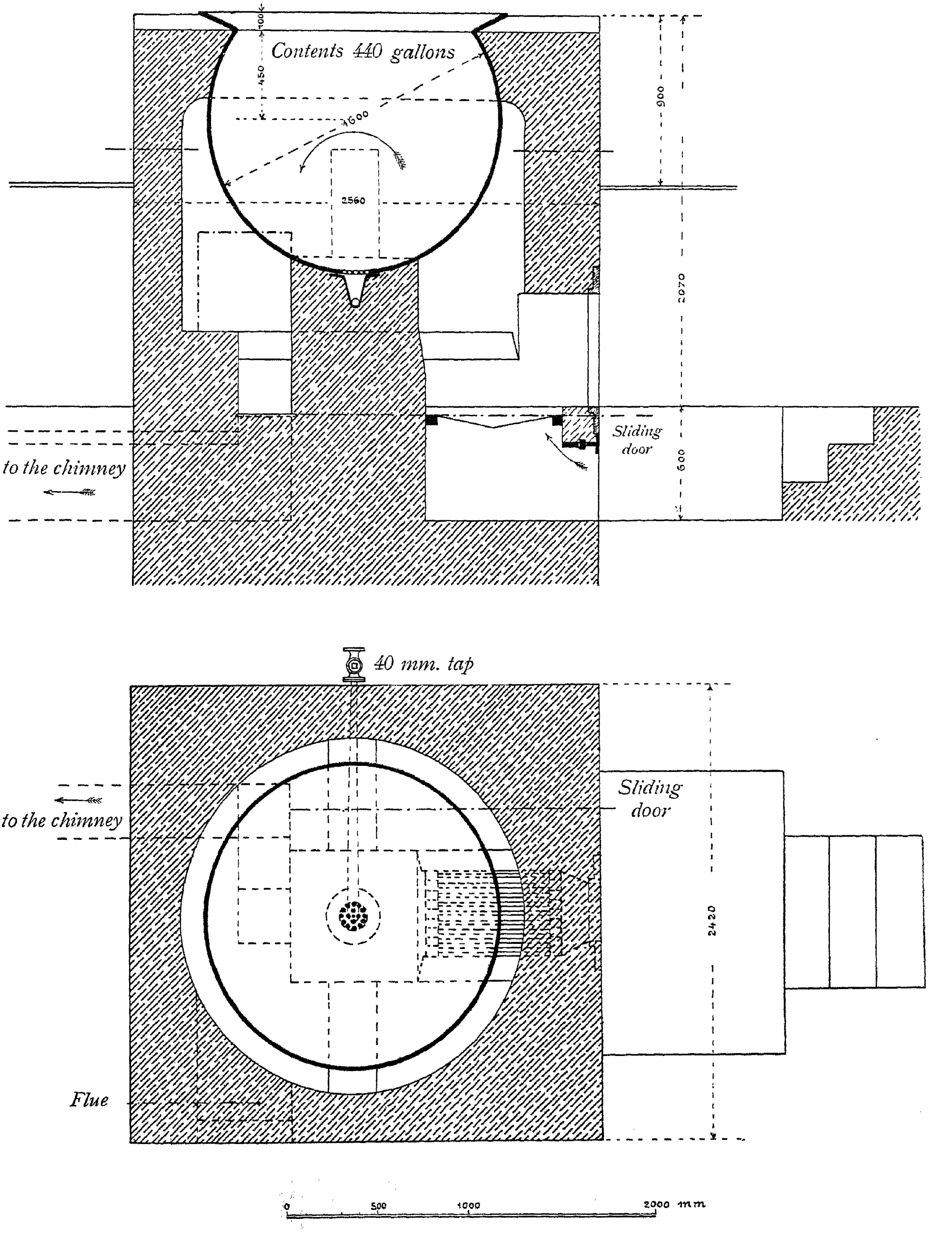


Table 11.

Boiler for wool-dyeing heated by direct fire.

Contents = 440 gallons.



Dye-vat for piece-goods.

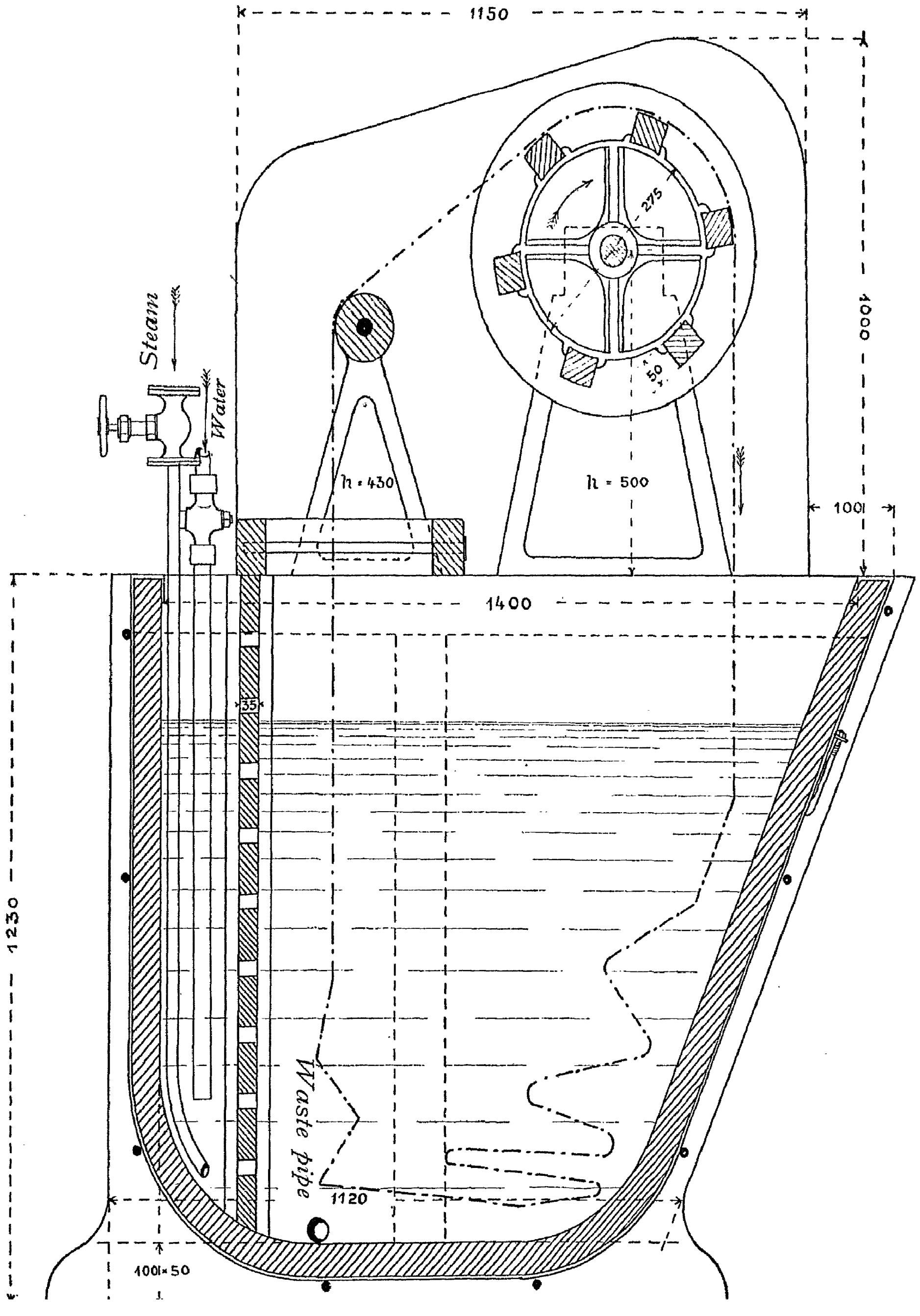
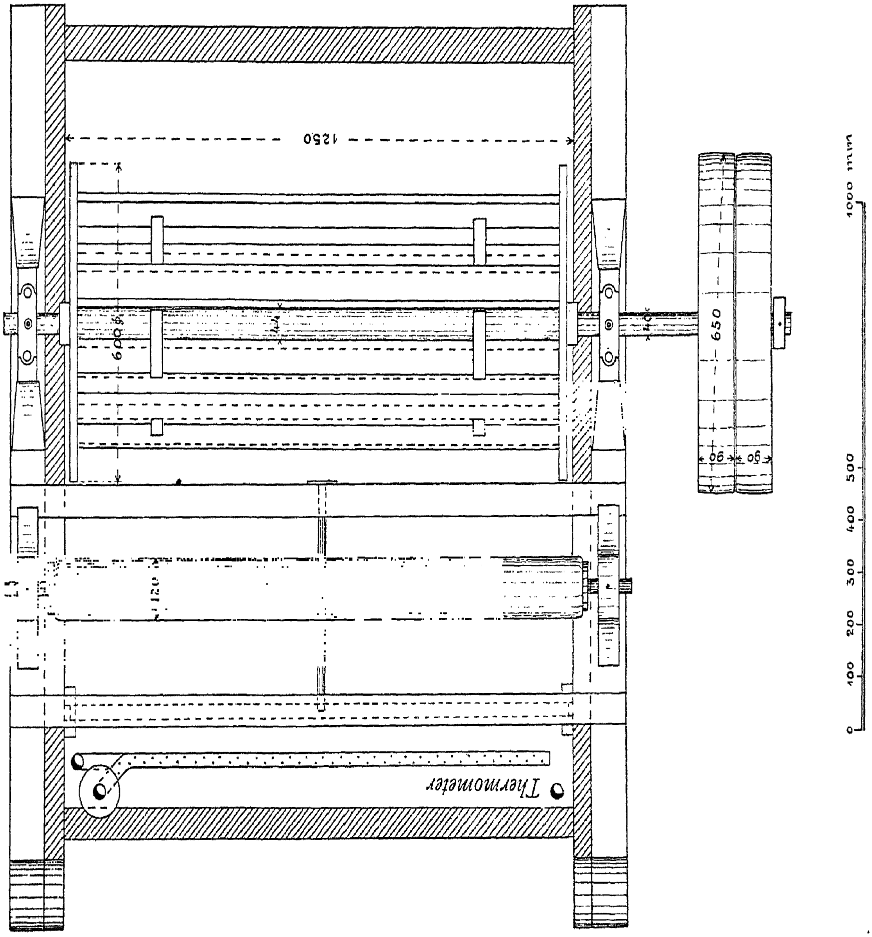


Table 12.


Thermometer
1000 mm

Dyeing Machine

Obermaier & Co., Lambrecht.

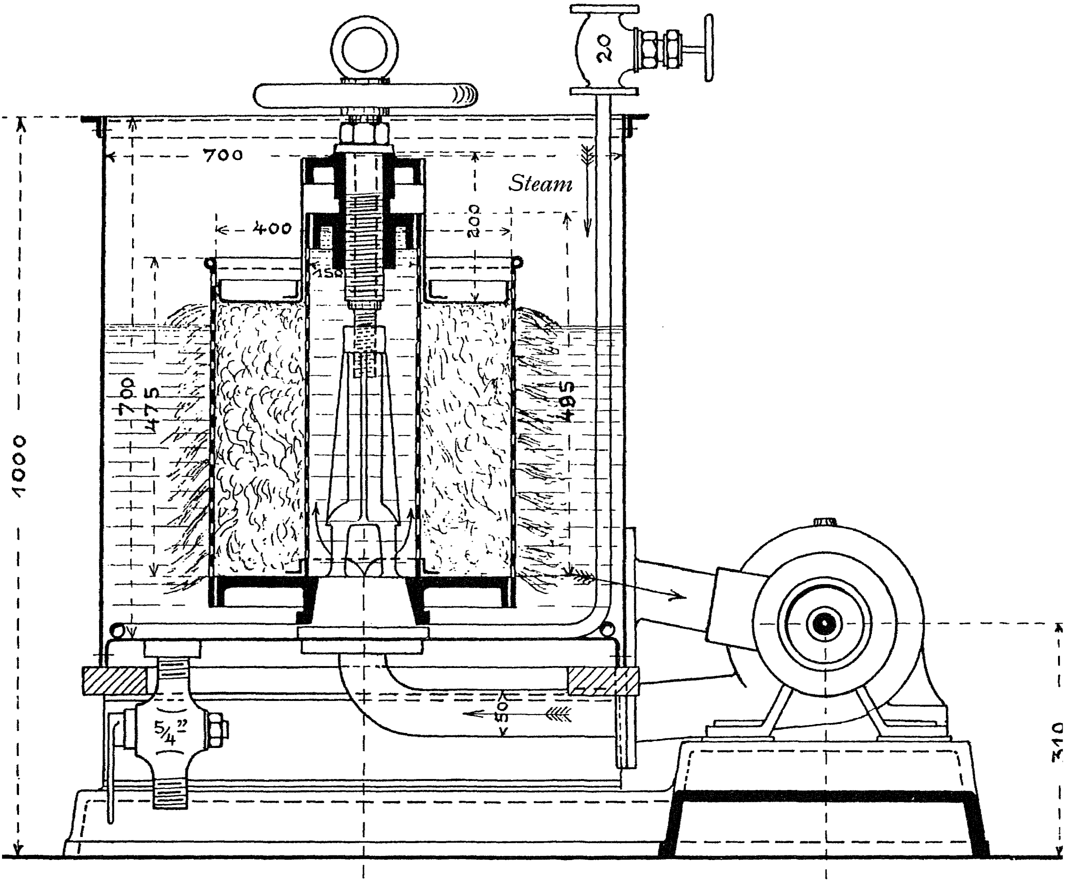


Table 13.

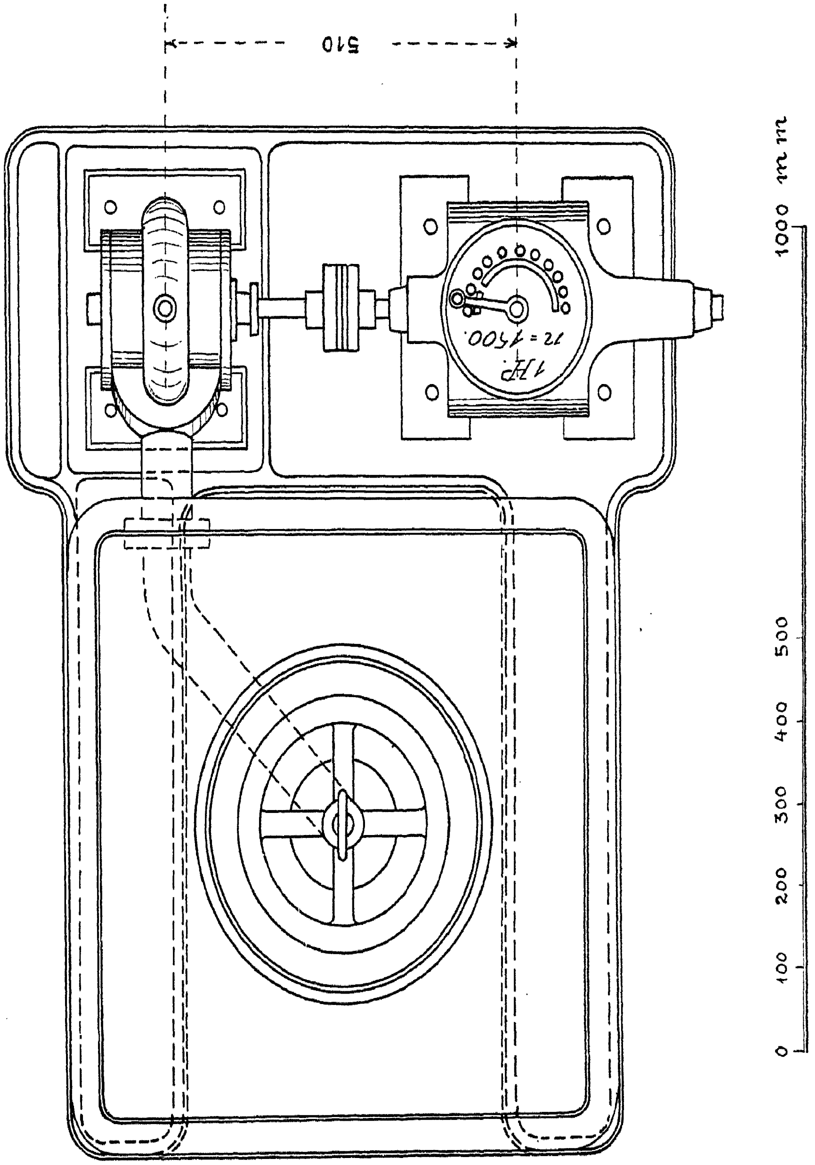


Table 14.

Dyeing Machine

Schmidt, Langensalza.

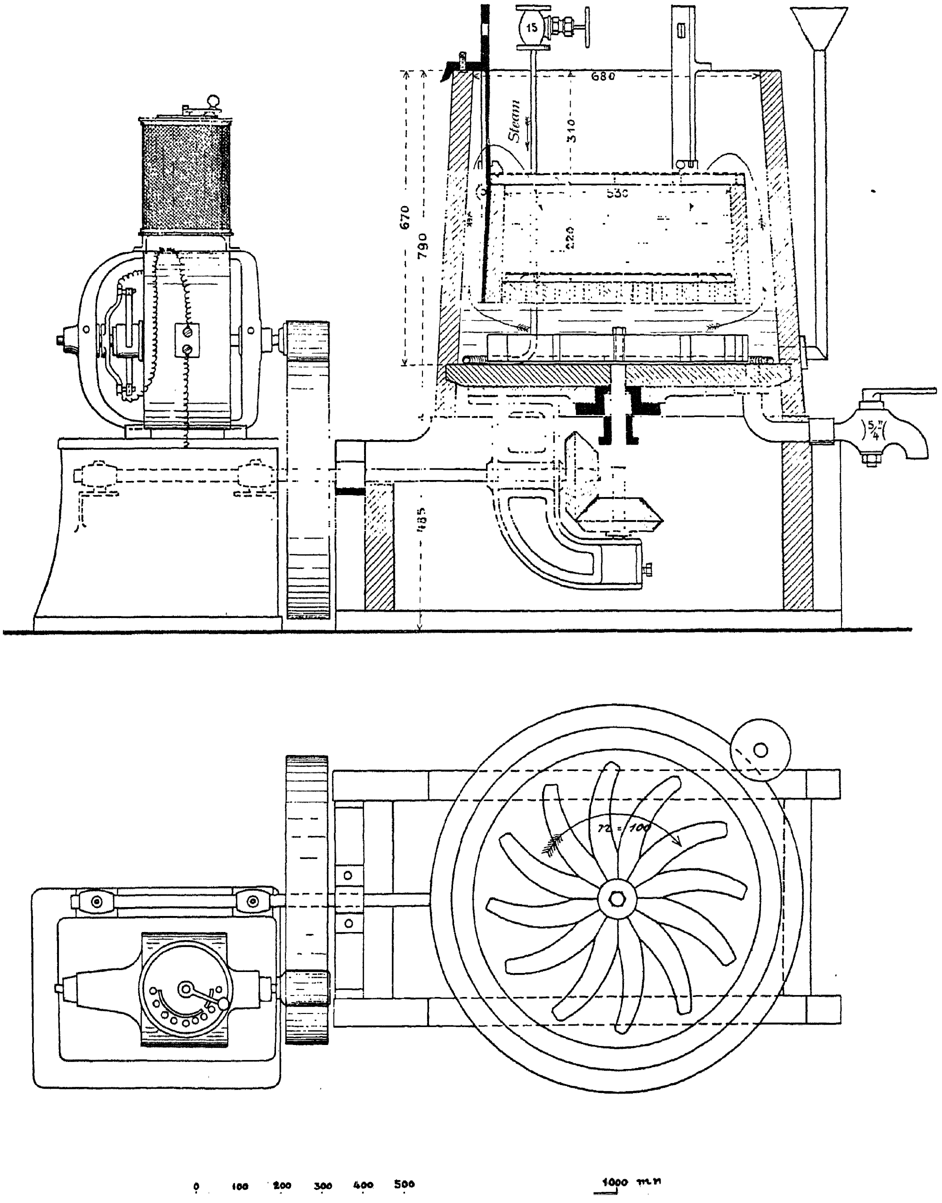
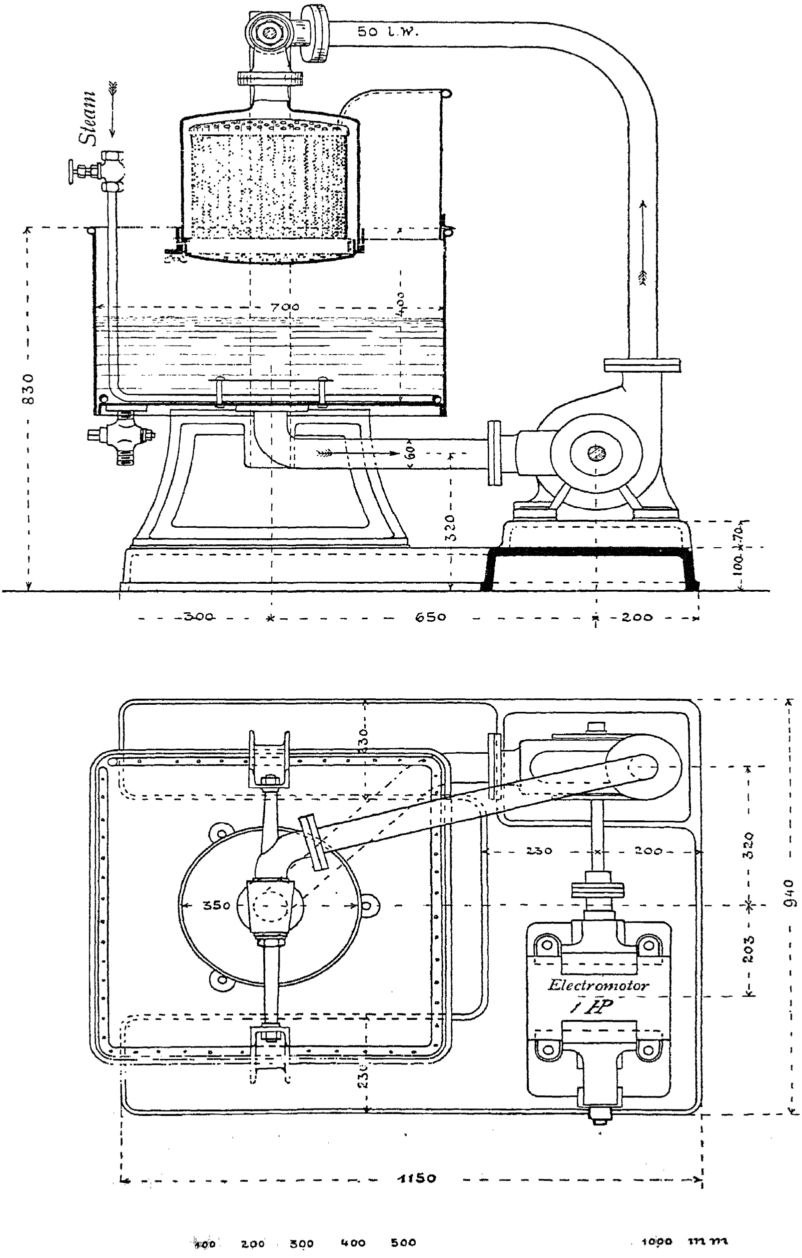


Table 15.

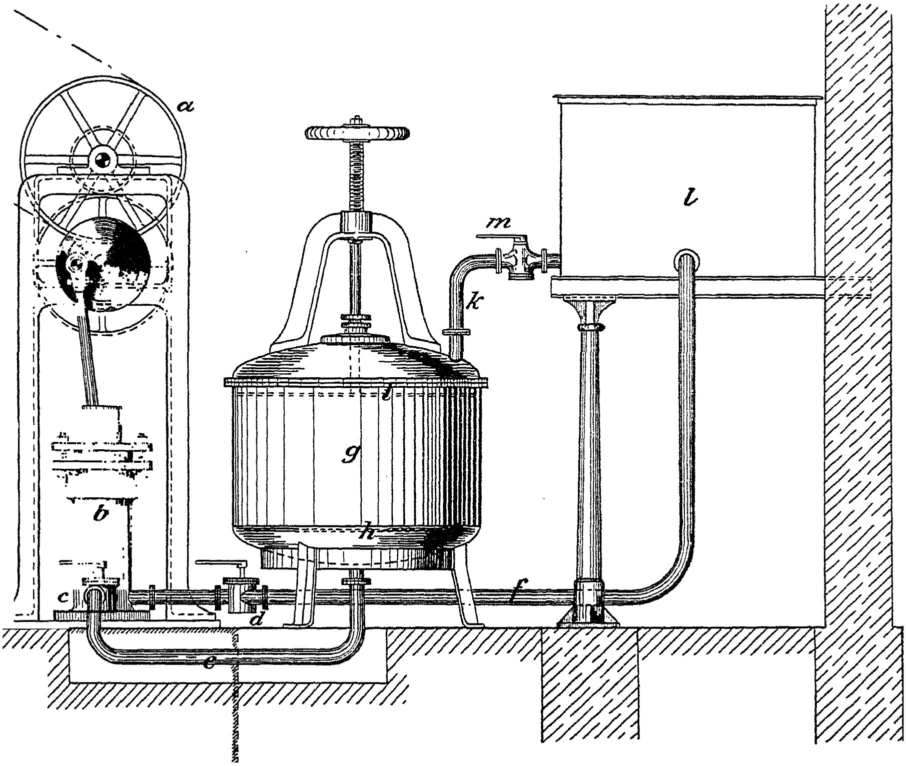
Dyeing Machine

Schulze, Schmölln.



Dyeing Machine

H. Schirp, Barmen-Rittershausen.



Dyeing Machine

Drèze-Michaelis, Verviers-Cottbus.

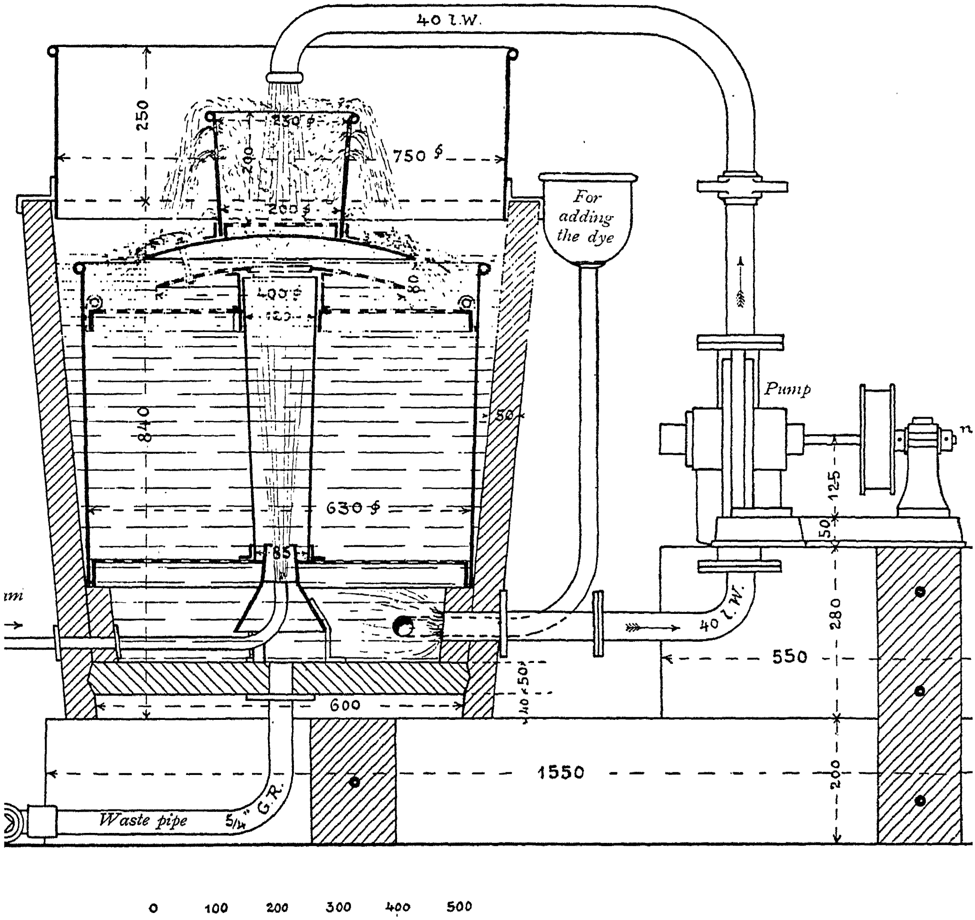


Table 18.

Dyeing Machine

Skène & Devallée, Roubaix.

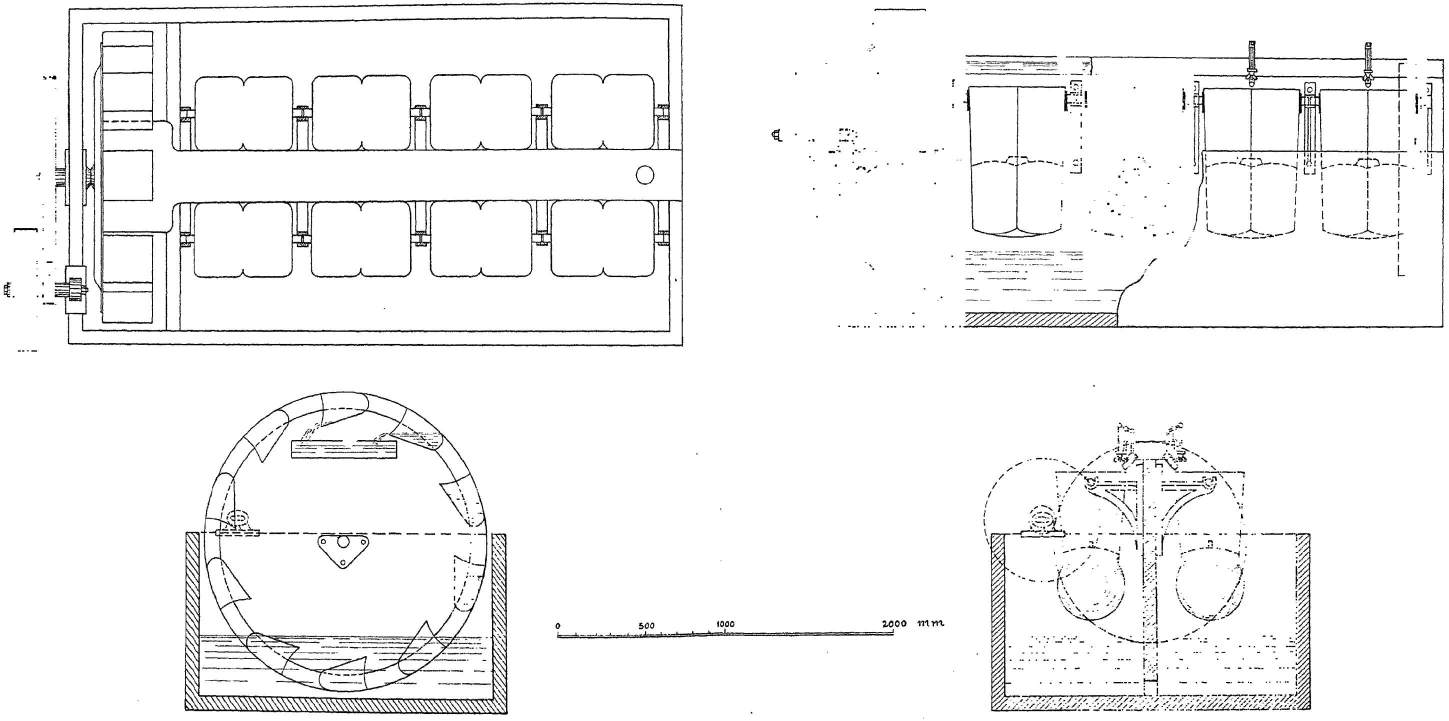
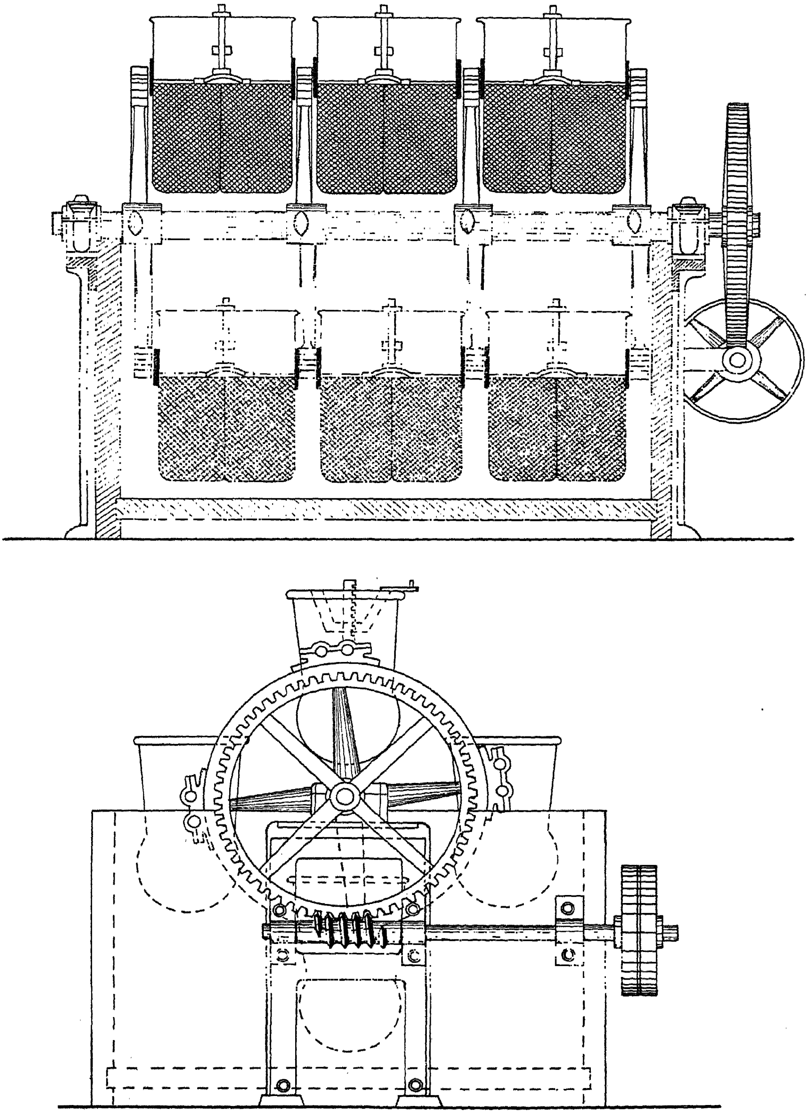


Table 19.

Dyeing Machine

Harmel frères, Val-des-Bois.



Yarn-dyeing Machine

The Klauder-Weldon Dyeing Machine Company,

Huddersfield.

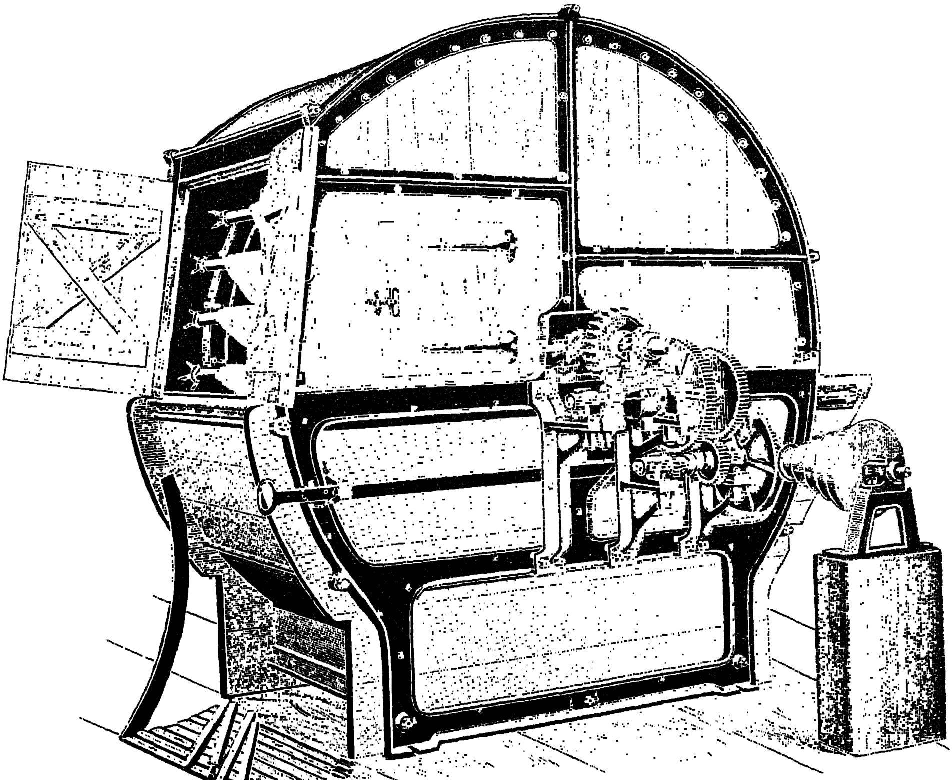
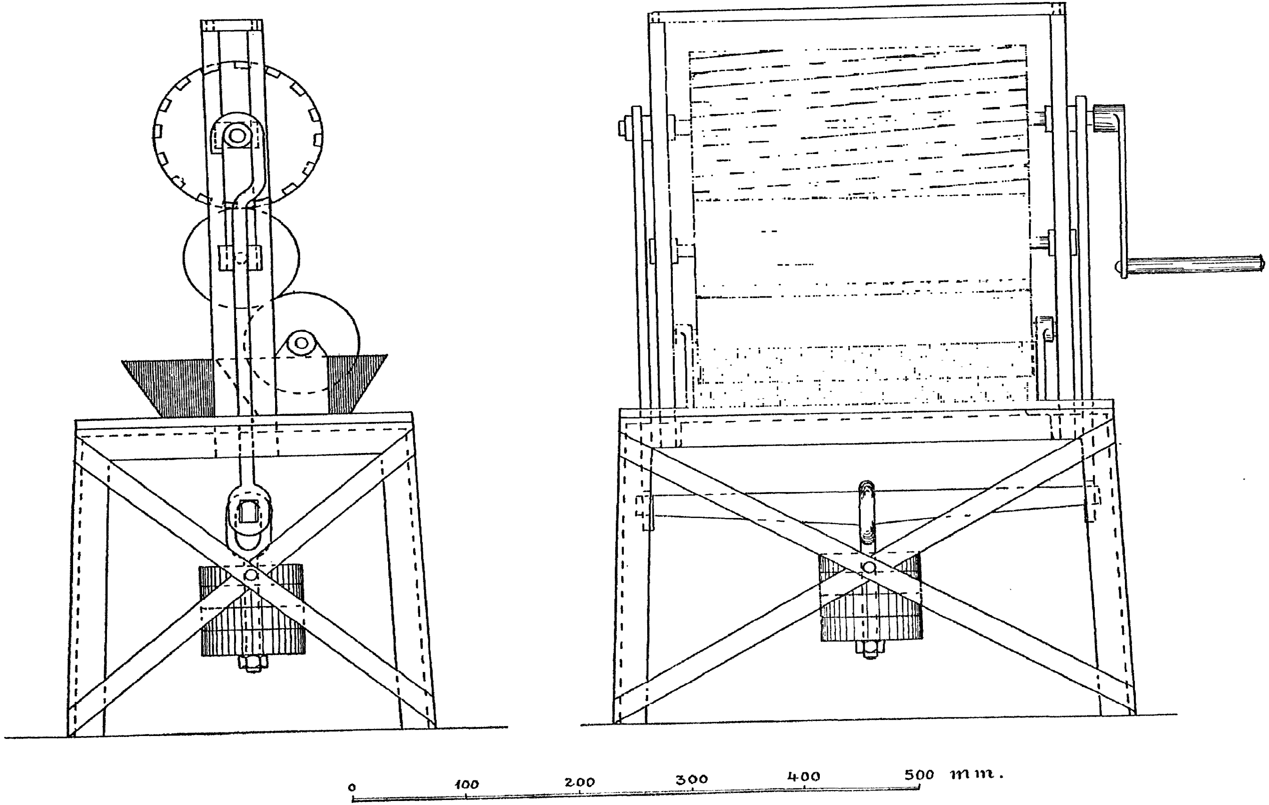


Table 21.

Model of

Slubbing-printing Machine (System Vigoureux,



Iron Jigger.

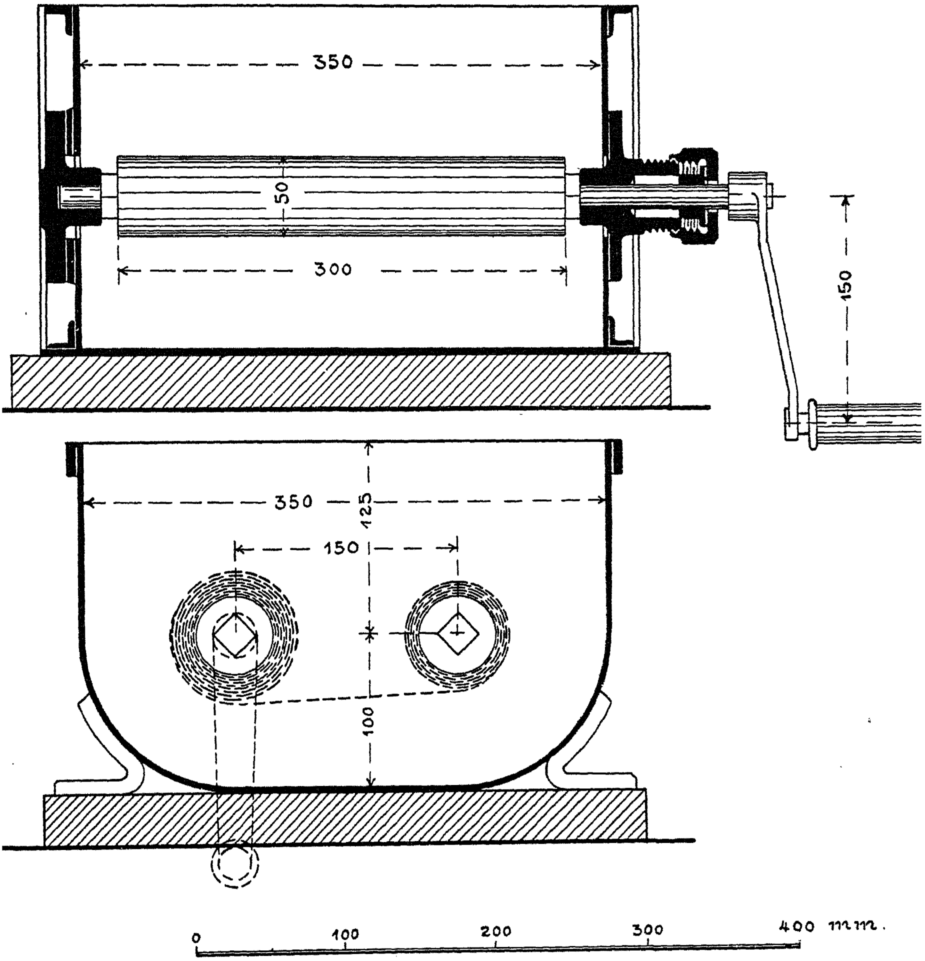


Table 23.

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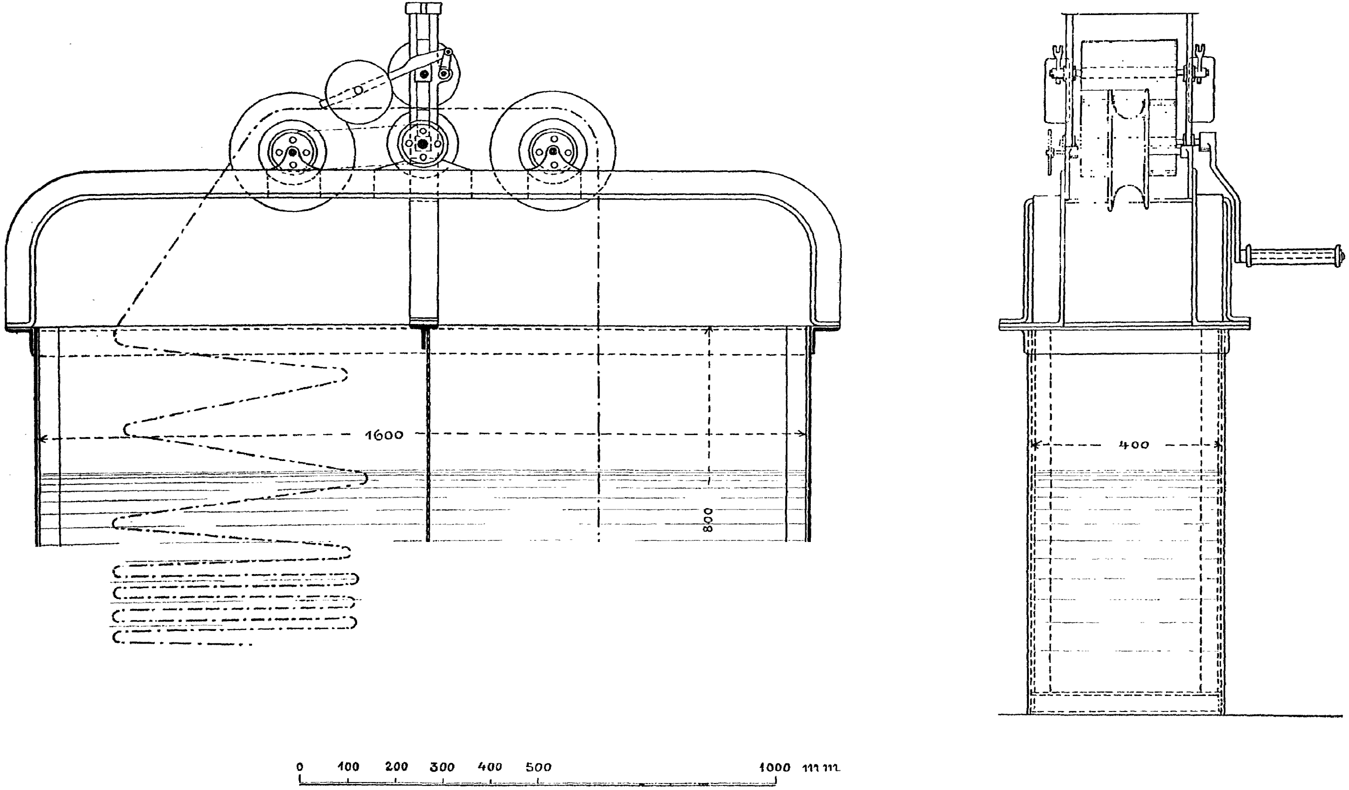

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